Virginia Tech
Capital Bikeshare Study
A Closer Look at Casual Users and Operations

Prepared by

Virginia Tech
1872

DRAFT
December 2011

Prepared for

cb
capital bikeshare

ARLINGTON
VIRGINIA

d.

Table of Contents

I. Executive Summary

Capital Bikeshare (CaBi) has generated detailed demographic profiles of both its annual and monthly system subscribers, yet has not gathered adequate profiles of its casual users. This report is the first in-depth look into the makeup and characteristics of this group, constituting of both 1- and 5-day CaBi members ("casual users"). Given the elusiveness and greater revenue-per-ride earnings of this group, CaBi would benefit from gaining a better understanding of casual users, aiding efforts to increase ridership and improve system functionality. This report also details best-practices amongst similar bikesharing systems worldwide with the goal to inform future improvements to CaBi's operations.

Intercept surveys at the five highest traffic bikeshare stations resulted in nearly 340 survey responses providing insight into those who purchased 1-day and 5-day memberships. Analysis revealed that the average casual user is a well-educated, Caucasian female between the ages of 25 and 34, a frequent cyclist, a domestic tourist and travels with a group. The gender, racial and group elements of this casual user differs from both the profile of the typical CaBi annual member and the typical Washington DC bicyclist. Additionally, a majority this audience reported that they learned about and decided to use CaBi based on either seeing the CaBi stations, or being referred by a friend. If CaBi wishes to attract more casual users, targeted marketing tactics could include enhancing the visibility and availability of bicycles in high-tourist traffic areas, reaching potential tourist users by marketing through their hotels and transportation providers, and focusing marketing messages on the social aspects of bicycling.

The purpose of the second part of this study was to gain a better understanding of bikeshare systems and their operations worldwide. Through a series of outreach and research efforts, detailed responses from eight contemporary systems were collected and analyzed with the goal of selecting applicable best-practices for CaBi to improve their operations and procedures. In many respects, CaBi is already at the leading edge of the industry in maximizing ridership, however several areas of potential improvement were noted.

Rebalancing efforts have the potential to become more technologically sophisticated, including the use of predictive modeling and route mapping for balancing vehicles. This would have the secondary benefit of reducing reliance upon institutional knowledge of staff members, thus reducing the impact of staff turnover. Satellite storage and repair facilities will be needed as the system expands further from the main location in Washington, District of Columbia (D.C.). Targeted marketing to low-ridership regions and under-represented groups could have the benefit of improving balancing and capitalizing on existing infrastructure while broadening the membership base. Exploring true peak station demand through the use of unannounced "bottomless stations" was highlighted as an important method for informing potential enhanced operations corridors. The efficiencies of balancing vehicles in the CaBi fleet was questioned as well, given that they are in the minority of systems by not employing open trailers.

4

II. Introduction

Over the course of the Fall 2011 semester, Virginia Tech Urban Affairs and Planning students from the Alexandria Center participated in an Environmental Planning Studio focused on Capital Bikeshare. This Urban Affairs and Planning Fall Environmental Studio class ("studio class") was run by Professor Ralph Buehler and included the participation of eleven graduate students. The graduate studio group was charged with two main tasks, 1) to learn more about the 24-hour and five-day members of the CaBi program, and 2) assess best practices in the operation of bike sharing systems elsewhere and identify lessons for D.C.

CaBi is a public bicycle sharing system that operates in D.C. and in Arlington, VA. The system has been in operation since September 20th, 2010 and currently has approximately 1,100 bicycles and 114 stations. The system is the successor of the smaller SmartBike D.C. program that was in operation between 2008 and 2010 with 120 bikes in ten stations. CaBi is operated by Alta Bicycle Share who is responsible for the maintenance of the system, operation, and balancing of the system through a contract with the D.C. Department of Transportation ("DDOT") and Arlington County Commuter Services. The red CaBi bikes are produced by the Public Bike System Company ("PBSC") from Montreal, Canada. PBSC operates the system's call center and billing/membership program.

Over its first year of operation the CaBi system exceeded ridership expectations, reaching its one-millionth ride on the first anniversary of the system's operation. The system has been very well embraced by both D.C. and Arlington County where it is in operation. Several other surrounding jurisdictions, including Alexandria, VA and Montgomery County, MD, are currently planning to expand Capital Bikeshare to their communities[1]. Both D.C. and Arlington have system expansion plans in place and underway which will add 74 new stations, 34 in D.C. and 30 in Arlington, with expansions planned for many other existing stations as well[2].

III. Objectives

The objectives of the Virginia Tech Bikesharing Studio project were to:

1. Develop a profile of 24-hour and 5-day CaBi causal users and make recommendations to CaBi management to improve the experience and increase the number of casual users; and

2. Analyze best-practices information from other bike sharing operations worldwide to suggest system operations improvements.

1 Sullivan, 2011
2 Capital Bikeshare, 2011

IV. Capital Bikeshare Casual User Survey

CaBi conducts its own online surveys of annual and monthly members ("annual members"); however, it does not collect similar information about casual users. This annual member data is compared to the data we were able to collect from casual members. Data was collected through in-person intercept surveys at automated "docking stations," where customers pick-up and return bicycles. The goal is to evaluate preferences, transportation routes, locations, ease of use, and pricing information in order improve the overall system operation, fill information gaps, and increase sustainable transportation options in and around D.C. The following section speaks to the survey methodology and accompanying logistics.

A. Methodology

The studio class used an intercept survey to collect data about the system's casual users. After creating the protocol for implementation and data collection, the studio class selected optimal dates, times and stations to collect data in the field.

B. Survey Construct / Instrument

Starting with a client meeting and list of potential survey question categories (user profile, bike history, trip purpose, CaBi system / bike infrastructure and pricing), the survey questions were narrowed down to 20 questions and three observations.

Surveys were conducted on two weekends in late September and early October (9/23-9/25 and 9/30-10/3) with one make up weekend (10/8-10/9) for inclement weather. Dressed in business casual, weather appropriate attire and displaying Virginia Tech name badges and clip boards, the class worked in teams of two in four hour shifts at stations selected for their high traffic volumes. Survey participants were chosen based on a minimum age of 18 and identified on-site by researchers at CaBi station

locations. Handout survey slips for accessing the survey online were provided to any participants unable to complete the survey questions in person.

Map of survey locations (Google Maps)

C. Stations / Locations

Based on data provided by Alta noting the stations with highest usage by casual users, five locations were selected for intercept surveys:

- Dupont Circle (Dupont Circle NW & Massachussetts Ave. NW)
- USDA (12th St. SW & Independence SW)
- Federal Triangle (10th St. NW & Constitution NW)
- Georgetown (C&O Canal & Wisconsin Ave NW)
- Eastern Market Metro (Pennsylvania Ave. SE & 7th St. SE)
- 19th St. NW & Constitution Ave. NW*

*Station subsequently removed from survey due to construction at the site

D. Constraints

An intercept survey was the most appropriate data collection technique at hand; however, such a survey is prone to several disadvantages. Due to time constraints, little baseline data could be collected from casual users without sacrificing the time dedicated to obtaining other pertinent information. Other disadvantages included the limited number of researchers conducting surveys and the time constraints of participants that may have resulted in missed surveying opportunities or "walk aways."

Inclement weather during the second scheduled weekend also posed an issue for data collection. Several survey teams had to reschedule to the following weekend due to turnout at the selected CaBi stations.

E. Analysis
1. Demographic Profile
a. Race

Predominantly, the CaBi casual users surveyed were non-Hispanic whites. At 78%, this closely follows the percentage of white annual members, cyclists in the D.C. Region, and cyclists in other U.S. urbanized areas. Compared to these other three demographic groups, CaBi casual users represented the most diverse user population with 22% non-white, as opposed to only 12% non-white for the D.C. Region cyclists[3].

African Americans represent a small but consistent percentage of cyclists in all four groups. At 2-7%, the number of African American cyclists is disproportionately low relative to the population that makes up D.C., where half of all residents are African American [4]. This disparity may be hiding certain inequalities, (user) preferences and socio-economic factors, but CaBi should

3 Buehler et al., 2011
4 U.S. Census Bureau, 2011; Buehler et al., 2011; Capital Bikeshare, 2010

Race of Casual CaBi Users

Race: US Urban Area Cyclists
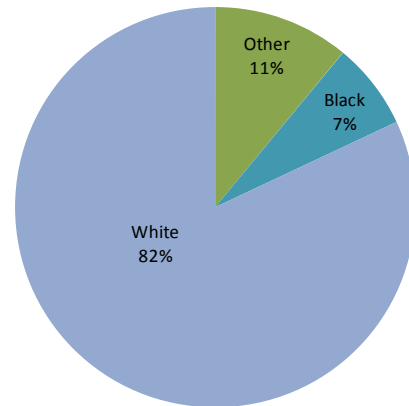
Race: 2010 Washington DC Census

Race: CaBi Annual Members
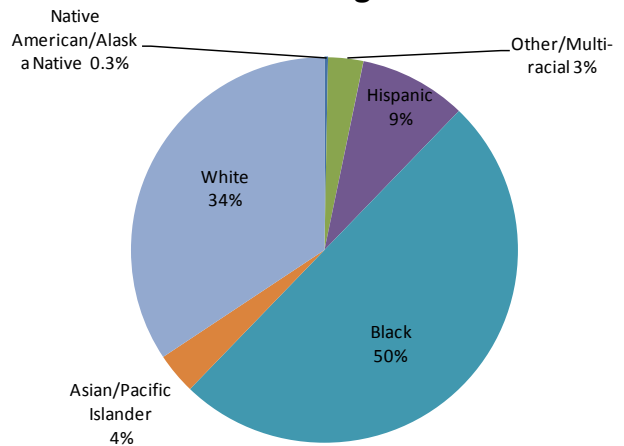
Race: DC Region Cyclists
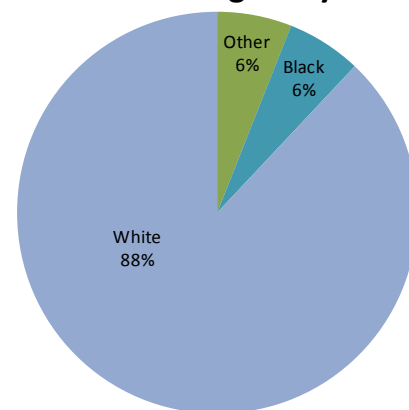
Sources: (Capital Bikeshare, 2010; Buehler, Hamre, Sonenklar, & Goger, 2011; U.S. Census Bureau, 2011)

take note of this relatively low percentage of current African American CaBi casual users and annual members.

b. Gender

In urbanized areas within the U.S., cycling is dominated by males who typically account for three-quarters of all cyclists [5]. In the D.C. Region, the gender ratio among CaBi annual members is slightly more balanced with roughly two-thirds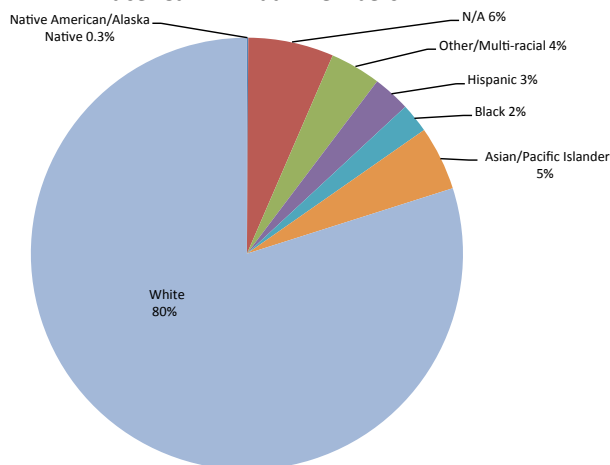 members being male [6]. In contrast, the CaBi casual user survey indicated that the majority of survey respondents (52%) were female. This ratio of 52% Female-to-48% Male closely follows the broader census data for D.C., and is a significant departure from the typical 25-33% market share that female cyclists represent [7].

It is important to note that the casual user survey only inventoried the gender of the survey respondent and did not track the gender of any other casual users in the group traveling with the respondent. Almost three-quarters of all survey participants

5 Buehler et al., 2011
6 Capital Bikeshare, 2010
7 Buehler et al., 2011

Gender: DC Region Cyclists

Female 33%
Male 67%

Gender: Casual CaBi Users

Female 52%
Male 48%

Gender: US Urban Area Cyclists

Female 25%
Male 75%
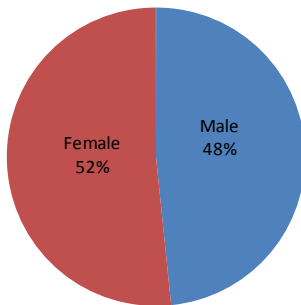
Gender: Annual CaBi Members

Female 33%
Male 67%
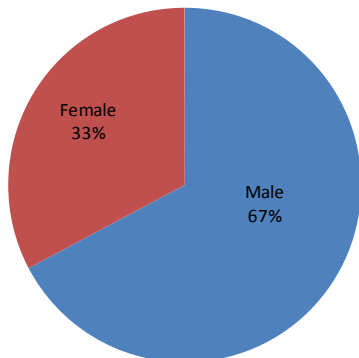
Gender: 2010 DC Census

Female 53%
Male 47%
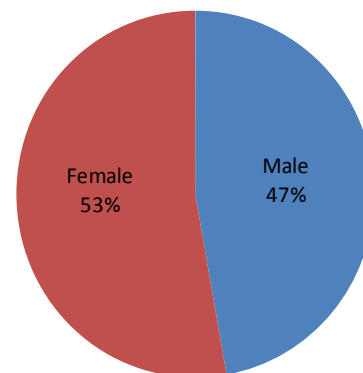
Sources: (Capital Bikeshare, 2010; Destination D.C., 2010; U.S. Census Bureau, 2011)

traveled in groups of two or more, with a predominant preference for using the system in pairs. This strong preference for group use of the CaBi system by casual users, combined with the limited survey scope, indicates that the number of female survey participants documented may not be a precisely accurate representation of the gender trends of overall CaBi casual users.

c. Education

CaBi users, both casual and annual, are highly educated. Only 6% of all casual user survey participants had a High School/GED/or Less education, while the remaining 94% had at least some college experience. One distinguishing characteristic for casual users is that the largest education group identified was "Advanced Degree" with a 43% respondent share. The 2-year, 4-year, and Advanced degree trends were very similar between CaBi casual users and annual members [8]. Additionally, the data indicates that CaBi casual users are more highly educated than the typical DC tourist, who are in turn, significantly more highly educated than

_____

8 Capital Bikeshare, 2010

Education: Casual CaBi Users

Prefer not to answer 0%
High School/GED or Less 6%
Some college 8%
2 Year College Degree 3%
4 Year College Degree 40%
Advanced degree (Masters, Doctoral) 43%

Education: DC Tourists

High school/GED/or Less 15%
Some college 26%
2 or 4 Year College degree 34%
Advanced degree (Masters, Doctoral) 25%
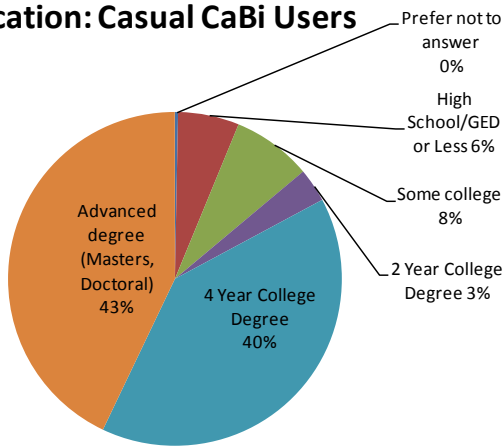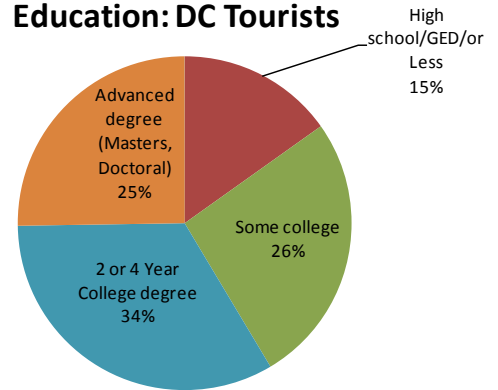
Education: Annual CaBi Members

Prefer not to answer 15%
High school/GED or Less 0.2 %
Some college 3%
2 Year College Degree 1%
4 Year College Degree 42%
Advanced degree (Masters, Doctoral) 39%
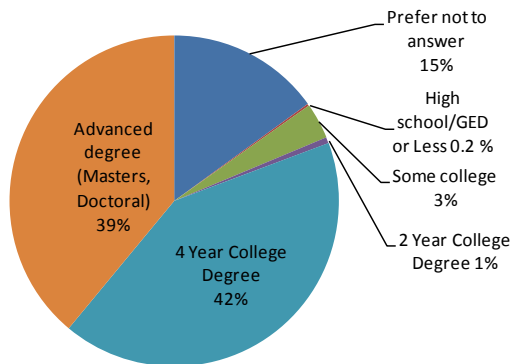
Education: 2010 DC Census

College Graduate (2 or 4 Year Degree or Advanced Degree) 47%
High school/GED/or Less 53%
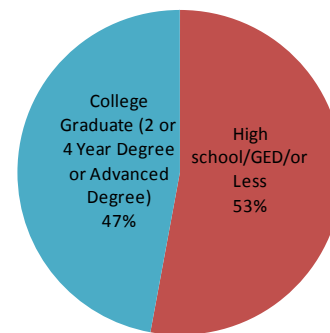
Sources: (Capital Bikeshare, 2010; Buehler et al., 2011; U.S. Census Bureau, 2011)

residents of the District of Columbia [9].

Of the Educational Attainment groups, the Advanced Degree group has the highest percentage of "Frequently Ride on City Streets" responses at 45% as well as the lowest percentage of "Rarely Ride a Bicycle" responses at 22%.

d. Age

As results indicated, the ages of casual user survey participants are very similar to annual members. The largest variations between the two groups was seen in the 18-24 and 25-34 years old age groups with variations of 6.9% and 8.3%, respectively. However, collectively these two youngest age groups in both surveys accounted for approximately 60% of all riders [10].

There was a 53 year age difference between the youngest rider

9 Destination D.C., 2010; U.S. Census Bureau, 2011
10   Capital Bikeshare, 2010

Age: Casual CaBi Users

Age: Annual CaBi Members
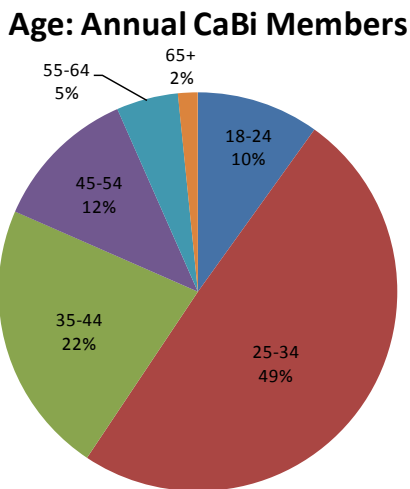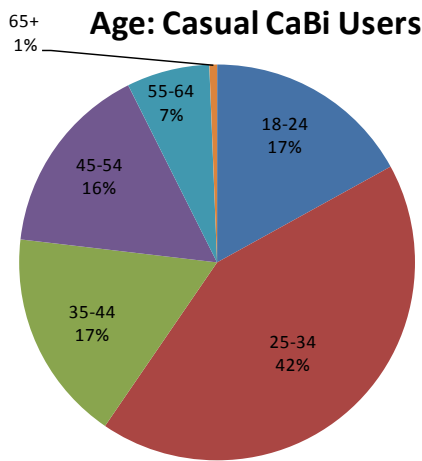
Age: DC Region Cyclists
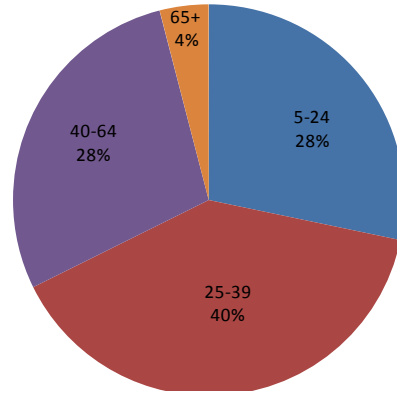
Age: US Urban Area Cyclists
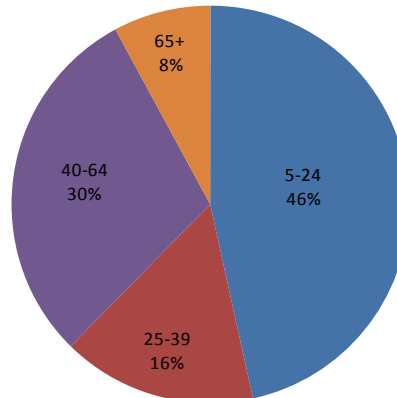
Age: DC Tourist
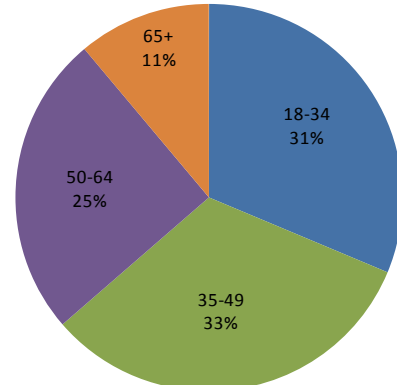
Age: 2010 Washington DC Census
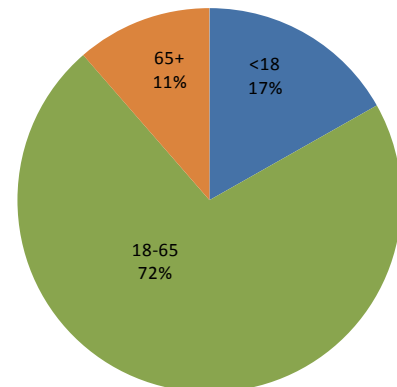
Sources: (Capital Bikeshare, 2010; Buehler et al., 2011; Destination D.C., 2010; U.S. Census Bureau, 2011)

surveyed at 18 years old and the oldest survey participant at 71 years old. The wide age range of casual users demonstrates the program's flexibility and ability to serve users of all ages. Other key statistics associated with the age of the survey participants include an average age of 34 years and a median of 31 years old. Both the average and median ages fall within the 25-34 year old age group which was the most frequent age group, representing more than 42% of the casual user survey participants. Further, this group had a high level of Bicycle Experience with more than 55% reporting that they frequently bicycle.

2. "Typical" Casual User Profile
A typical CaBi casual user could be described as:
- Gender: Female (51.33%)
- Age: 25 - 34 years (41.3%)
- Mean: 34.64
- Median: 31
- Mode: 25
- Race: Caucasian (78.17%)
- Education: Advanced Degree (42.9%)
- Tourist/Local: Domestic Tourist (53%)
- Bicycle Experience: Rides Frequently on City Streets (41%)
- Helmet: No (92.6%)
- # in Group: 2 (57.5%)
- Pass Type: 24-Hour pass (96.46%)
-

3. Station Profile

Among casual users at the three most popular stations in the survey (Dupont Circle, USDA, and Federal Triangle), approximately half fell into the Domestic Tourist category (52%, 57%, and 50%, respectively). International Tourists accounted for approximately 17% of all casual users surveyed at the USDA and Federal Triangle stations but less than 5% at the Dupont Circle station (no International Tourists were recorded at the Georgetown or Eastern Market stations, however, so few riders were surveyed at these stations as to be inconclusive). This may indicate that the International Tourist population is more prone to use CaBi for touring around the Mall but that may not choose CaBi to explore the neighborhoods of D.C.

4. Pass Type

Overwhelmingly, the 24-hour pass was preferred to the 5-day pass by the casual users who participated in the survey. Further, of the 98% of the survey participants that were 24-hour members, more than 70% were first-time users. The few 5-day members interviewed were more highly divided, with 43% first-time users and 57% repeat users. This may be attributed to a consumer preference for a lower cost/lesser commitment option or when potential users cannot make full use of 5-day membership blocks.

Surveys by CaBi Station and Tourist Profile
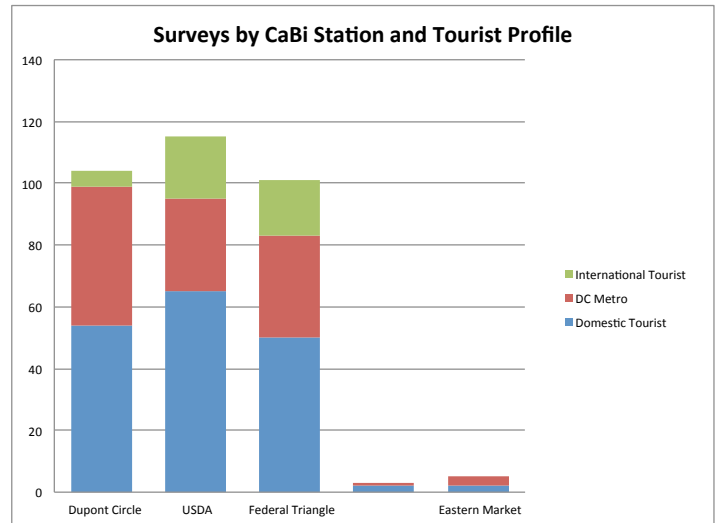
Casual User Geographic Profile

10
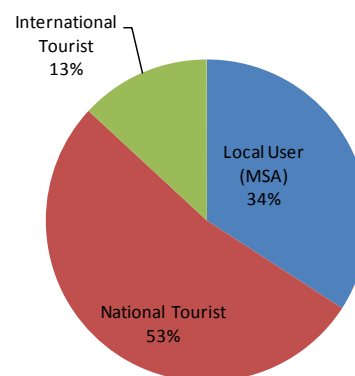
5. Zip Code

More than half of the casual users surveyed were identified as Domestic Tourists (53%), a trend that closely follows the findings in a report by Destination DC, a non-profit tourism corporation specializing in the D.C. area. In the Destination DC report, it was found that 80% of Domestic Tourists to the D.C. area originate from just 14 states [11]. For comparison, 81% of the Domestic Tourists from the CaBi survey also came from only 14 states; 12 of which match with the 14 states described in the Destination DC report (Appendix A.D). Destination DC's list includes Maryland and Michigan while the CaBi casual user survey top 14 includes Connecticut and Arizona. This appears to indicate that domestic tourists using the CaBi system are a fair reflection, in terms of geographic origin, of the overall tourist numbers and trends seen in the D.C. metro region.

The Destination DC survey from 2009 identified 16.4 million visitors to D.C. each year; 14.8 million (90.2%) of whom were Domestic Visitors with the remaining 1.6 million (9.8%) as International Visitors. In contrast, the CaBi casual user survey identifies that out of the respondents not from the DC MSA, 80% were Domestic Tourists and 20% were International Tourists. While Domestic Visitors from the CaBi survey closely mirror the distribution of Domestic Visitors from the Destination DC survey, there is a large disparity regarding International Tourists between the two surveys with the portion from the CaBi survey double that of the Destination DC survey. It is worth noting that several of the International Tourists from the CaBi survey hailed from traditionaly bicycle-friendly countries such as Germany, England, Sweden, Holland, Belgium, France, and Denmark. This may indicate that visitors from bicycle-friendly countries, some of which may already be familiar with bikeshare programs, may be more likely to utilize the system. As bike sharing systems continue to proliferate worldwide this trend could be expected to continue.

11 Destination D.C., 2010

Users Bike Experience w/ Bike Lane Satisfaction

CaBi Casual User Bicycling Experience
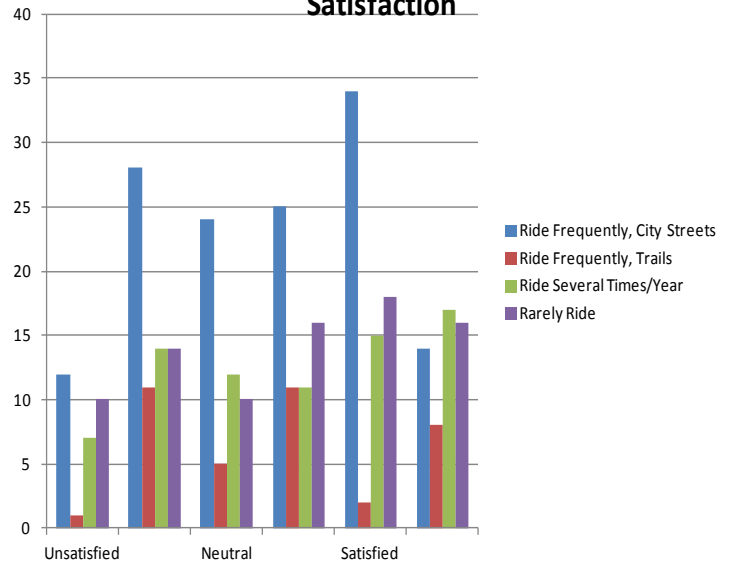
Users Age Group and Bike Experience
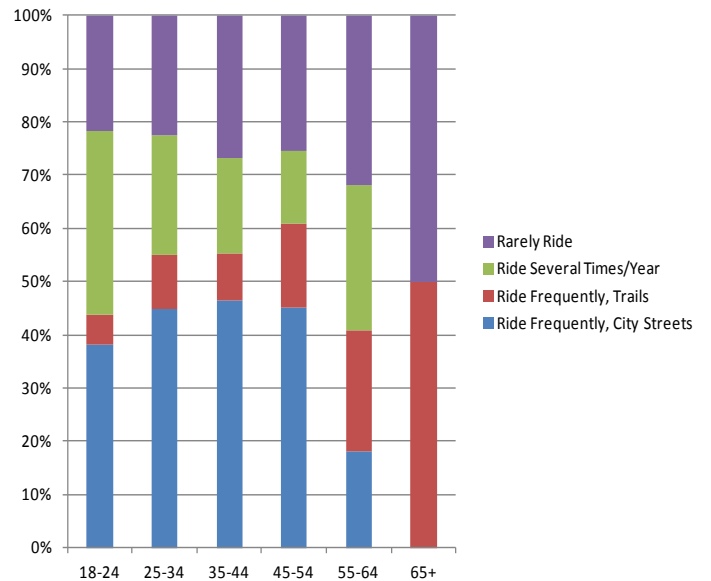
6. Level of Bicycle Experience and Opinion of Bike Lanes

We found that typical CaBi casual users had substantial bicycle experience, with 41% of respondents indicating frequent use on city streets and 22% riding several times a year. A quarter (25%) of respondent indicated a rare use of bicycles. The 25-34 years old age group (the largest age group among casual users) held the largest percentage of those claiming to ride a bike frequently.

Overall most CaBi casual users were generally unsatisfied with DC Metro bicycle lanes, with those claiming they were "unsatisfied" or "somewhat unsatisfied" making up 43% of respondents and those claiming "satisfied" or "somewhat satisfied" only making up 29%.

7. Reasons for CaBi Use

More than half of the CaBi casual user survey respondents identified "Tourism/Site Seeing" as their primary reason for using CaBi on the day they were surveyed. These overall trends

Frequency of CaBi Use

national Tourist group had the highest internal percentage of the "Tourism/Site Seeing" reason for use at 84%, and the lowest percentage of "Social/Personal" use at only 2.3%. The Domestic Tourist group fell into the middle with a 60.8% internal percentage for "Tourism/Site Seeing" and an 20% internal percentage for "Social/Personal".

Very few users identified "Work/Meeting" as their primary use of CaBi, though this could be due to the fact that surveys were primarily conducted on weekends. Although "Transportation" was not provided as a selection on the survey, 7% of casual users surveyed stated that their reason for using CaBi that day was for transportation purposes.

8. First Time Use of CaBi

Of the surveyed respondents, 71% identified themselves as first time users, while the other 29% were identified as repeat users. Of the 100 respondents identifying themselves as repeat users, 25% had purchased a 1-day or 5-day pass four or more times prior. The mean number of times repeat users had used CaBi previously was 2.6 times. Overwhelmingly, both new and returning users purchased 1-day memberships, though those with no experience were nearly four times more likely to purchase a 5-day membership.

Reasons for CaBi Use

(reflected in the chart above) vary significantly when the survey respondents are grouped by their "Tourist Status" (D.C. Metro Region, Domestic Tourist, International Tourist). As would be expected, of these three groups the D.C. Metro Region user group had the lowest internal percentage of the "Tourism/Site Seeing" reason for use at 27.5%, and the highest internal percentage of "Social/Personal" reason for use at 37%. Conversely, the Inter-

Satisfaction With Metro DC Bicycle Lanes

Helmet Use and Bicycling Experience

Number of Casual Users in Group
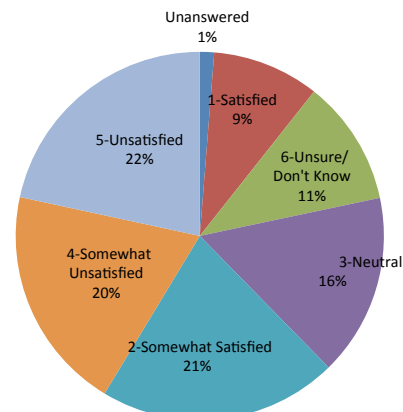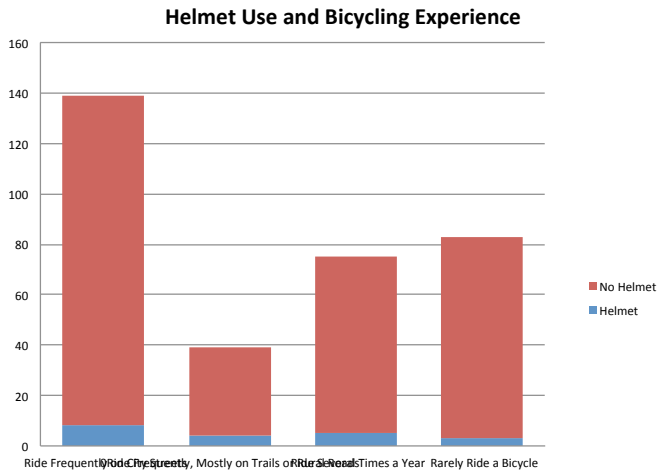
Observed Helmet Use

Researchers conducting the surveys observed whether casual users were wearing helmets. The overwhelming majority of casual users (94%) did not wear a helmet. Bicycling experience level did not appear to greatly correspond to helmet use. Nearly 6% of the most experienced urban riders, those who reported that they "Rode Frequently on City Streets," wore a helmet. Likewise, 4% of the least experienced riders, those reporting that they "Rarely Ride a Bicycle," wore a helmet (though this group may also be less likely to own a helmet). The group with the highest helmet use, 10%, were those who reported that they "Ride Frequently, Mostly on Trails or Rural Roads."

Not wearing a helmet did not appear to deter casual users from CaBi. However, some users stated for the "What About CaBi Would You Most Like to See Improved?" survey question a preference for having helmets available for use (see "15: Improvements" below).

Surveyors observed the number of CaBi users traveling together. Survey results showed that three quarters of casual users traveled in groups of two or more. While 25% of casual users were alone, 54% traveled in pairs with the mean group size being two. Roughly 9% of groups contained three riders, while there were relatively few groups of four or greater.

The high percentage of casual users in a group might inform rebalancing efforts to ensure availability of two or more docks/bikes at stations with high casual user rates. Groups require a
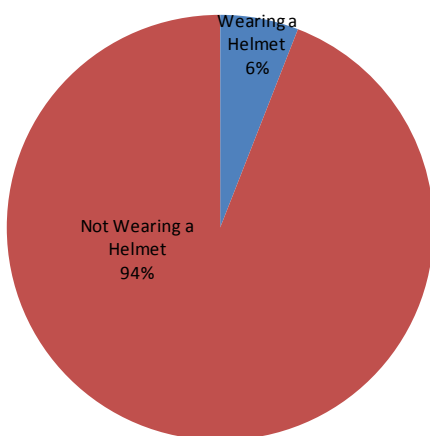
Trips Replaced By CaBi
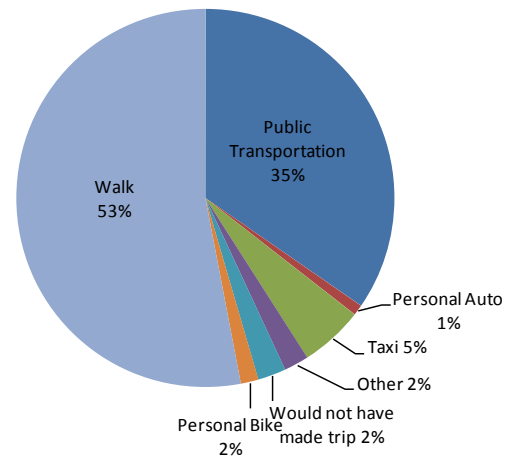
larger number of bicycles to rent simultaneously and empty docks at which to concurrently return bicycles. A station with one bicycle available would be considered "empty" for a group of casual users. Conversely, a station with only one available dock will not allow a group of casual users to return bicycles together.

10. Trips Replaced by CaBi

The vast majority of casual users surveyed stated that CaBi served to either replace public transportation (Metrorail, Metrobus, or Circulator) or walking trips (typically by either shortening travel time or increasing travel range). At only 1%, Personal Auto was the least common mode of transportation replaced in favor of CaBi. Despite this low percentage associated with the personal automobile trip replacement, almost 20% of all survey respondents indicated that they arrived in D.C. via personal automobile. This may indicate that while CaBi casual users may not represent significant direct reductions in personal automobile use, the CaBi system is providing a new and welcome alternative way for people to travel around and explore the D.C.

It is also worth noting that of the 2% of casual user survey participants that selected "Other", the majority would have used a traditional bicycle rental program (such as "Bike-and-Roll") if CaBi was not in existence. Only one survey participant identified each: tour bus, double-decker bus, and Pedicab as the mode of

transportation they would have selected absent the CaBi system. Based on these results it does not appear that CaBi represents a significant reason for shifting a notable share of users from any private transportation/tourism options that operate along the National Mall.

11. Spotcycle

A majority of CaBi casual users had never heard of Spotcycle. However of the 40% who had heard of Spotcycle, 62% had previously used it. This is a slight lower percentage of users than compared to CaBi annual members, of whom only nearly 70% use Spotcycle.

12. Other Transportation Modes

When asked what other modes of transportation were used in connection with their CaBi trip, more than 75% of respondents indicated that they had either walked or used public transportation.

How Users Learned About CaBi

Transportation Modes Used in Connection with CaBi Trip
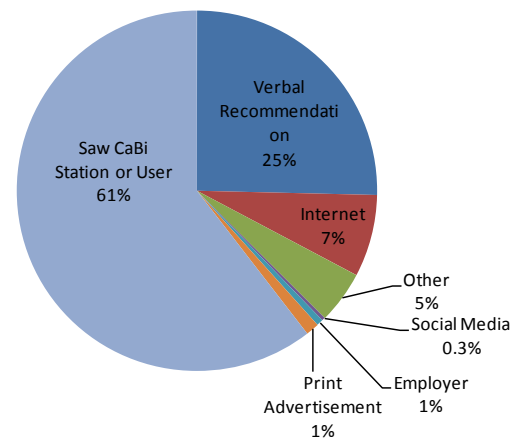
How Users Learned About CaBi
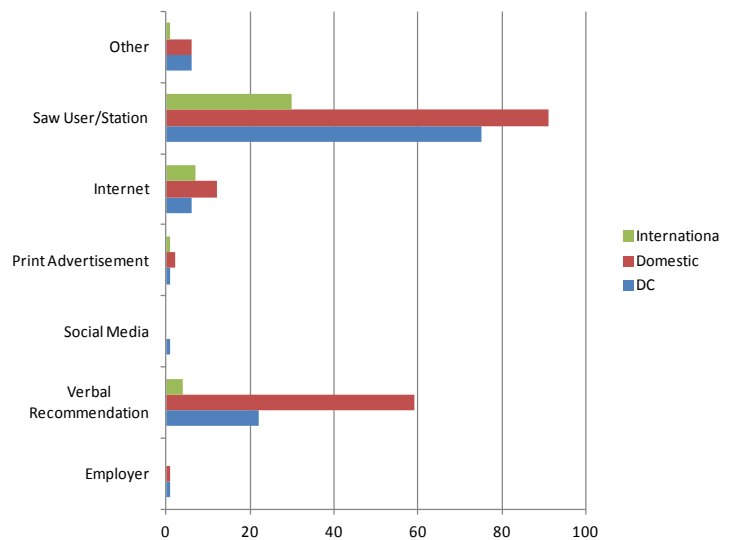
How Age Groups Learned About CaBi

Legend: 18-24, 25-34, 35-44, 45-54, 55-64, 65+

Categories: Employer, Social Media, Internet, Other

13. How Users Learned about CaBi

The most common means by which users first learned of CaBi was seeing the system itself, which represented 61% of respondents. This is followed by verbal recommendations for the system, presumably by people who have either used the system previously or seen it in operation. The other options include the Internet, social media, employer, print advertisement, and other, and only account for 14% of respondents together.

These trends held true regardless of age and visitor status. Across almost all visitor categories, the top three responses were "saw a user/station," verbal recommendation, and Internet, following that order. The one exception to this was that for Inter-

national Visitors, "Internet" was a more common answer than "Verbal Recommendation." This may be explained by the fact that International Visitors are less likely to have established personal contacts familiar with the system, or they may have done more travel research on the Internet in preparation for their trip.

Similarly, the responses of learning about the system by seeing the system itself or having it verbally recommended are the top two responses in each age group category. The other, more traditional advertising measures that Capital Bikeshare has undertaken are less represented. Only one user identified Social Media as the means by which they discovered CaBi, and only 7% of casual users learned about the system from the Internet.

Percentage of Casual Users Who Have Heard of Spotcycle

Have Heard of Spotcycle 40%
Have Not Heard of Spotcycle 60%
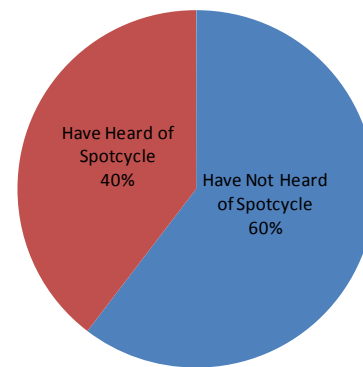
Reasons for Not Purchasing Annual CaBi Membership

Number of Responses

Reason	Number
Don't Live Here	232
Not Frequent Enough User	70
Other	14
Evaluating the service	12
Own a personal bike	10
Don't Know/None	6
Cost	6
Inconvenient Stations	4
System Reliability	1
Unanswered	1
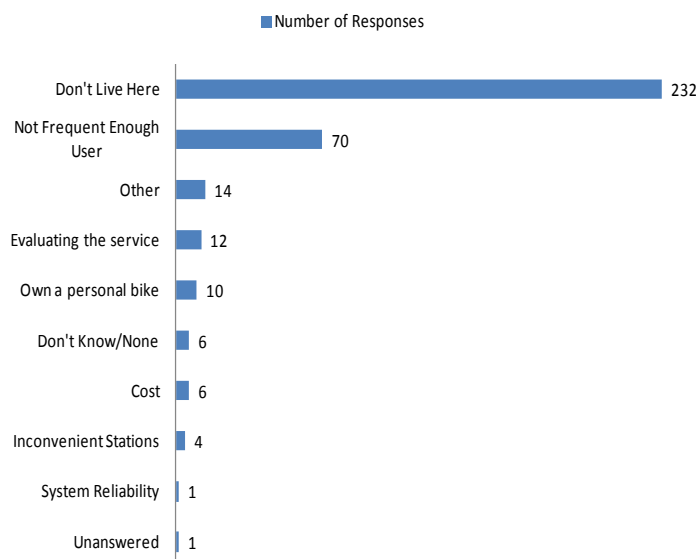
Desired CaBi Improvements

Responses

Improvement	Number
More Stations/Bikes	144
Don't Know/Unanswered	66
Better Maps	62
Better Balancing	56
Better Kiosk	39
Lower Cost	38
Other -Misc	20
Bicycle Comfort, Features*	18
Printed Map of CaBi System*	13
Helmet Rental at Stations*	8
Better Station Visibility*	6
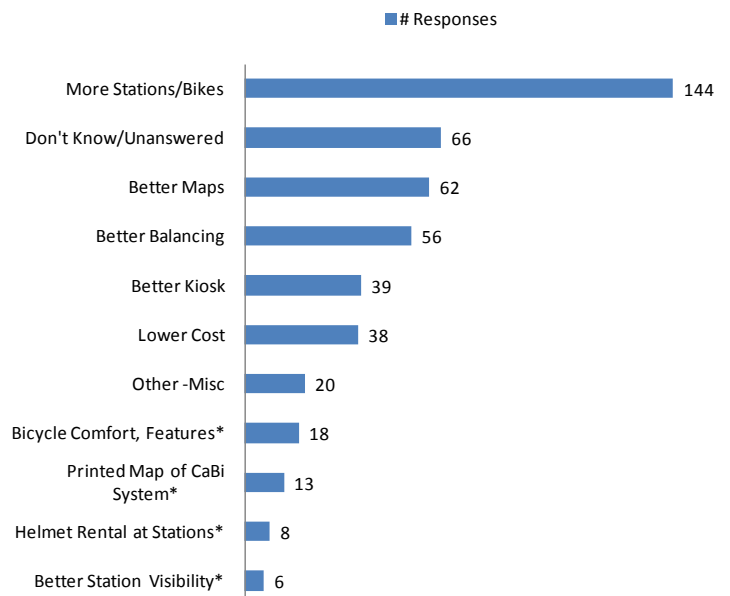
14. Reasons for Not Purchasing Annual Membership

Casual users were asked why they purchased a 1-day or 5-day pass instead of an annual membership and given the option to answer all that apply. Of the respondents, 64% stated they are not an annual member because they do not live close enough to benefit from an annual membership, while nearly 20% say they would not be a frequent enough user to justify the purchase of an annual membership.

15. Desired Improvements

Casual users surveyed were asked what about CaBi they would like improved, and given the option to select all answers that apply. Over 30% of survey respondent answers suggested they would like CaBi to add more station locations and bicycles. Beyond the 12% of respondents who were unsure as to how to improve the CaBi system (presumably due to little CaBi experience), better maps and better station balancing came in at 12.5% and 12% respectively. A larger percentage of answers, over 16%, fell into the "other" category, of which survey time and design constraints may have played a factor. Answers of "Other" were sorted into four distinguishable categories indicated with an asterisk in the graph:

1. Bicycle Comfort, and Features
2. Printed Map of CaBi Stations to take with rider
3. Helmet Rental at Stations

4. Better Station Visibility
5. "Other Misc." remaining for those responses that did not fit neatly into any).

In addition, we also noted improvements suggested by casual users informally in conversation before or after the survey. These suggestions are listed in Appendix A. The survey demonstrates specific desires many casual users would like to see either enhanced or added to the CaBi system.

Level of Ease in Understanding Pricing Structure
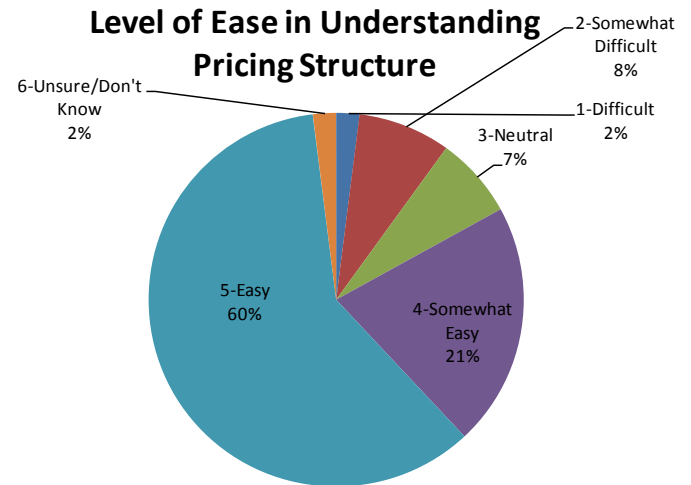
16. Additional Stations

At nearly 30% of the total responses, new stations around the National Mall pulled in the most requests from survey respondents. Downtown D.C. was the second most frequently desired location for more stations, at nearly 17%. Many CaBi casual users were unsure or didn't provide an answer to the question, most likely due to their unfamiliarity with bikeshare system and/or District in general (nearly 25%). Due to the broad nature of the "Other" category, responses were separated into distinguishable categories including:

Desired Locations for Additional CaBi Stations

Responses

Location	# Responses
National Mall	108
Downtown DC	68
Don't Know	55
Unanswered	45
Arlington	28
Near My Home	20
Montgomery County	20
Alexandria	18
Georgetown	8
Other	8
Near All Metro Stations	7
Dupont/Logan Circle	6
Fairfax	5
Columbia Heights/Mt. …	4
H Street NE	2
Prince Georges County	1
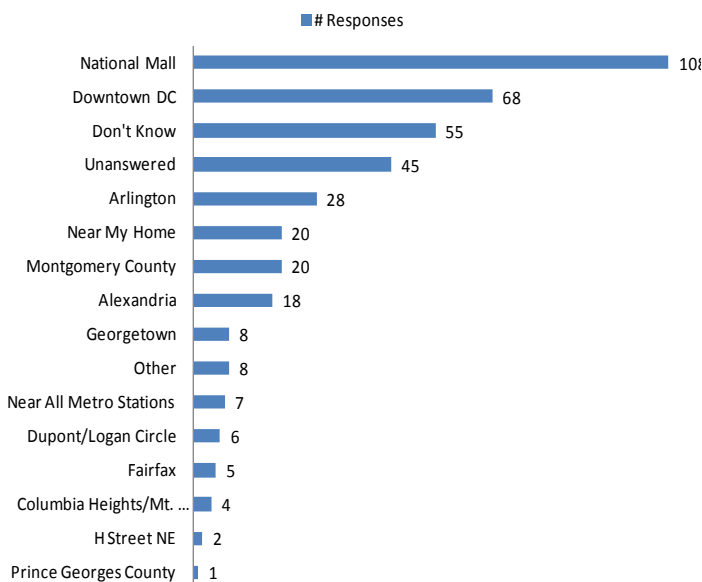
Level of Ease in Using CaBi Kiosk
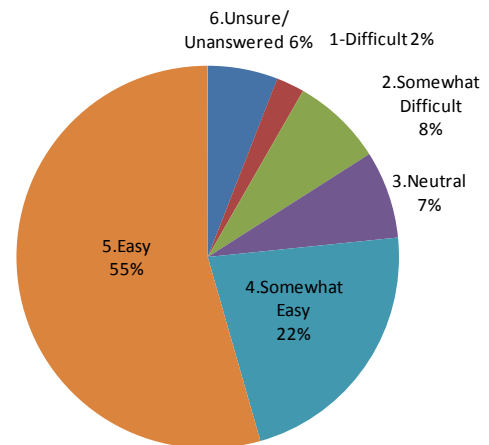
1. Near all metro stations
2. Dupont / Logan Circle
3. Fairfax
4. Columbia Heights / Mt. Pleasant
5. H Street, NE
6. Prince George's County

17. Pricing Structure Comprehension

Survey respondents were asked to rate their level of ease in understanding the pricing structure of Capital Bikeshare on a scale from "difficult" (1) to "easy" (5). Most users found the CaBi system to be either "somewhat easy" or "easy" to understand, with 81% responding as such. Though 10% responded negatively, believing the system "difficult" or "somewhat difficult" to understand. Of casual users, 8% stated they would like to see the pricing structure simplified, nearly matching those with a view that the pricing structure is difficult to understand. Additionally, only 7% who found the pricing structure difficult to understand were between the ages of 18 and 34, the largest age group of casual users. Of the 44 International Tourist respondents only 4 stated the pricing structure was difficult to understand.

18. Kiosk Ease of Use

Survey respondents were asked to rate their level of ease in using the CaBi station kiosk on a scale from "difficult" (1) to "easy" (5). Users gave the kiosk an overwhelmingly positive ratings. Roughly 55% of respondents gave the kiosk the highest rating of "easy." Moreover, greater than three quarters of users found the kiosk either "easy" or "somewhat easy" to use. Only 10% of respondents reported the kiosk to be "difficult" or "somewhat difficult," though the option "Better Kiosk" was the fifth most popular answer to the survey question on improvements to the system. (See Section 15: Desired Improvements and Appendix A for further details.)

F. Recommendations

This first in-depth look into the makeup of CaBi casual users. As stated previously in this report, CaBi has generated detailed demographic profiles of both annual and monthly subscribers of the system from surveys conducted by email, yet to date has not been able to gather adequate profiles of casual users. Our research is a snapshot in time of casual users of the CaBi system, conducted on weekends in late September and early October, yet it has shed light on the habits and intentions of this group. Given the greater potential of revenue per ride, CaBi may want to explore increasing use among 1-day and 5-day members.

The average casual user is a well-educated, Caucasian female between the ages of 25 and 34, a frequent cyclist, a domestic tourist and travels with a group. This profile stands out for a number of reasons, since most cyclists in D.C. and most CaBi annual members are male. Roughly 51% of respondents in our survey were female may suggest that CaBi – for casual use – holds a much more equitable share of women cyclists than otherwise. This may in part be due to survey methodology (gender was not accounted for with casual members traveling in groups, only that of the respondent).

That 75% of survey respondents were traveling in groups of 2 or more demonstrates that casual users view bikeshare as a social experience. Much of this can most likely be attributed to the fact that many survey respondents were International or Domestic Tourists (who may prefer to or are already traveling in groups), but this remained a noticeable trend at stations farther from the traditional tourist areas in Washington, D.C. Marketing to casual users could be designed to highlight the social aspects of seeing the city by bike as a way to differentiate CaBi from potential modes of transportation.

Among the five stations selected for survey collection, those closest to the National Mall had the highest numbers of casual users during the survey weekends. From an operational standpoint, it would be important to ensure adequate balancing in these prime stations to facilitate the higher revenue casual users – especially as CaBi may expand operations onto the National Mall in the near future. This is important given the preference for riding in groups - more bikes and more available docks are needed for larger groups.

Noticeably absent from the typical user profile is bikeshare use by minority groups – and particularly for D.C. with a large population of African Americans, use by African Americans is especially low. Several factors may have influenced this outcome, particularly that surveys were not conducted in areas where there are significant numbers of African American residents in D.C. Nonetheless, further research and targeted marketing efforts by CaBi into increasing minority use of CaBi is highly recommended.

The high percentage of casual users of the system who are visitors to D.C. shows the potential for CaBi to market to tourists, both International and Domestic. Notably, the best and most effective marketing for the system was simply the system itself. More users reported that they learned about the CaBi system by seeing a station and/or rider than all other ways combined. This indicates that increased visibility of the system through enhanced and expanded station locations will only serve to further expand the popularity of the system with casual users. The strong preference by casual users for additional stations on the National Mall indicates that any stations added in the direct proximity of the Mall will be in high demand. Casual users support this projection by identifying "more stations/bikes" as the top way that the CaBi system cold be improved. Continued expansion and adding density to the CaBi system, particularly around the National Mall and Downtown Core, is highly recom-

mended to increase system visibility and use by casual users. Additional signage at existing stations may help to increase that visibility as well, to capitalize on the existing infrastructure.

While the elimination or minimization of traditional marketing efforts in favor of using the funds to help expand the system can be suggested based on the survey results, that course of action is likely impractical. Marketing efforts to reach casual users should be considered and focused at the arrival locations of the Domestic and International Tourists. For these groups approximately 40% arrived by airplane, 10% arrived by Train (Amtrack/MARC/VRE), and 10% arrived by bus (MegaBus, Bolt Bus, etc). Coordinating strategic marketing with these arrival locations could be an effective way of introducing the system to arriving tourists. Further, targeted marketing should be considered at Metro stations that have close proximity to key tourist locations and which are well served by CaBi stations (such as Smithsonian Station, Union Station, and L'Enfant Plaza). Other targeted marketing campaigns could be designed to try and induce increased CaBi system use by other groups that are under represented in both the annual user and casual user surveys.

Additionally, because two-thirds of the casual users surveyed were either Domestic or International Tourists, the majority of which are presumably staying in local hotels, CaBi should considered innovative partnerships that can be reached with a variety of hotel operators and flags. CaBi has recently entered into an agreement with three Kimpton hotels in the District (Hotel Monaco Washington DC, Hotel Helix and Hotel Rouge) to provide daily memberships to hotel guests [12]. This program should be carefully studied and considered for expansion at other hotels with good CaBi station accessibility as a way to introduce more tourists to the system and expand the casual user population. This could include promotional efforts as well as educational materials for front desk and concierge staff. Also, several of the field observations (see Appendix A.B) suggested another partnership opportunity may exist. in which CaBi might partner with existing colleges in the D.C. Region to market the system at orientation events to new/transferring/returning students.

A focus to improving the user interface should also be considered by CaBi. While most respondents were satisfied with the kiosk interface, this should be kept in mind for future redesigns. Many users have their first and only interaction with the system through the station itself and not the website. Spotcycle was relatively unknown among this group - 60% had never heard about it - while it has the potential to improve the customer experience, thus potentially resulting in future usage. Increased promotion of the free smart phone application on the physical stations themselves might help to improve this.

The high number of casual users that were identified as being either "unsatisfied" or "somewhat unsatisfied" with the bicycle lanes and facilities indicates that enhanced ridership could be achieved through improvements to bicycle facilities. These improvements would be particularly welcomed by the almost 60% of casual users that did not identify themselves as cyclists that

rode frequently on city streets. We encourage the enhancement and expansion of bicycle facilities as a way to encourage greater levels of cycling and expanded use of the CaBi system by casual users.

Further, our results show that a significant portion of casual users are using the system for the first time. CaBi can stand to benefit greatly should many of these first time users become repeat customers. We recommend CaBi try to find ways to convince first time users to either purchase additional 24-hour passes or commit to annual memberships. Further research is also recommended to understand the level of correlation that exists between true casual users and those taking the system for a test spin who will eventually purchase a subscription.

V. Case Studies: An Analysis of Eight Select Bikeshare Systems from Around the World

A. Introduction & Methodology:

The purpose of the second part of this study was to gain a better understanding of bikeshare systems and their operations worldwide. We chose a case study methodology for this research using government documents, online databases, telephone interviews, and email exchanges to gather data on various systems.

Using the OBIS handbook[13] as a frame of reference, we established an initial set of questions that highlight the key areas of focus. Working along with our clients, the initial set of questions were then developed into a 12-question email survey to be sent to all systems, and a more specific, detailed list of questions for interviews.

For our outreach we developed two tiers of bike sharing systems: a top-tier of 20 systems that we were most interested in collecting information from and a second-tier of 180 remaining systems that we extended only initial outreach to. All of the systems we contacted were third generation bike sharing systems. The factors that went into the selection of our top 20 systems were: size comparable to, or larger than, CaBi diversity in the maturity and location of the system; language capabilities of our research team to conduct interviews; and selecting a range of business models. A table profiling the top 20 systems is included in Appendix B.

For the top-tier systems, our survey questions were translated into French, Spanish, German, and Italian. We also conducted extensive background research to identify specific individuals to contact, either affiliated with the system operator or with the respective city's department or ministry responsible for bikeshare. For the 180 second-tier systems, emails were sent to each system, and if interest was received from this initial email, we attempted to schedule phone interviews.

Our response rate was lower than desired, receiving responses from four top-tier systems and two second-tier systems. In addition to these responses, we conducted research on the Velib' system in Paris and two telephone interviews, including a follow-up interview with B-Cycle in Denver and a brief interview with OYBike in Cardiff, Wales. These findings form the eight systems reviewed in the following sections.

B. Case Study Analysis

This section will present the findings from our eight case study systems as well as provide an overview of CaBi's current practices and procedures in order to provide comparison. The findings are broken up into five broad categories: balancing; operations,

---

13 OBIS, 2011

Map of Bikeshare Case Study Locations
(Google Maps)

maintenance, and warehouse procedures; internal business operations; marketing and station siting; and finally, our conclusions, lessons learned and recommendations. Our eight case study systems are:

- Vienna's CityBike
- Barcelona's Bicing
- Mexico City's EcoBici
- Denver's B-Cycle
- Minneapolis's Nice Ride
- Kaohsiung's C-Bike, Paris's Velib'
- Cardiff's OYBike

Unless otherwise cited, all information on CaBi described in this section was gathered during a site visit to the Alta Bicycle Share facility, and a subsequent telephone interview with Danny Quarrell of Alta. Unless otherwise cited, all information on other bikeshare systems is taken from the responses to interview questions.

1. Balancing

With fleets of bikes ranging from 150 to 24,400 and nearly double the number of docks, balancing large scale bikeshare systems was the single largest reported challenge. We looked at the balancing and operations efforts of our case study systems to compare best practices and to highlight any unique tactics worth noting. Because balancing operations are comprised of numerous elements, responses are broken out by functional areas. First, we will characterize CaBi's balancing operations and then compare those to our pool of responses.

Capital Bikeshare Balance Vehicle
Source: beyonddc.com

a. CaBi

CaBi currently balances its system using four vehicles (3 Sprinter vans with a capacity of 28 bikes each and SUVs with limited capacity on racks), each staffed with a driver, and occasionally with an additional staff member. The driver is responsible for monitoring system status in their assigned zone via a laptop computer, providing real-time data via the online Oliver O'brien map and CabiTracker, a third-party developed program that displays station status. The driver then determines where to pick up and drop off bicycles, routing, locating parking, and performing work at the site based on that data and their own professional experience.

These rebalancing vehicles set up the system at night, refilling high-demand stations in preparation for the morning peak rush. Based on historical data on bikes replaced and removed during peak periods, Alta is able to determine the ideal system set for each station to ensure they will support the natural flow of users for as long as possible. This set is provided to the drivers in the form of a spreadsheet with the ideal number of bikes that should be at each station in preparation for the morning rush. This spreadsheet is updated periodically (every few weeks) by Alta's data manager, and adjusted by system staff based on current conditions and knowledge of past experiences.

During their morning rounds, rebalancing teams do their best to leave the optimal number of bikes at each station. As bicycles are ridden from outlying stations to the city core, rebalancing vehicles react to full and empty stations in assigned areas. Drivers have full authority to determine their own routes, the sequence in which they visit stations, and where they enter bicycles into service within defined zones. They are given guidance on optimal levels of bikes for stations at given times, but this guidance is not currently communicated from a central dispatcher.

CaBi indicated a possible future move toward a dispatcher model of service, which would relieve the driver of decision-making responsibility while in the field and has the potential to incorporate additional elements into the rebalancing process. For instance, it may be possible to layer local traffic information over the station maps to optimize the rebalancing vehicles' routes in real-time.

b. Peer systems

Geographic/Social Factors

The geographic and social characteristics of each city greatly impact the system performance and balancing needs.

Vienna mentioned that at night, most of the bikeshare traffic was headed out of the city center, the implication being that nightlife characteristics might help reset their system. This may be important to keep in mind when analyzing system resets for areas with active nightlife. Similarly, Kaohsiung cited weekends and holidays as their biggest balancing challenges and therefore

placed a stronger emphasis on optimal or special system sets for those situations.

Barcelona specifically mentioned that the elevation profile of their system area created specific balancing problems. The city is shaped like a large bowl, funneling most users downhill to the core with few willing to redistribute bikes back uphill. CaBi may see a similar problem but to a lesser extent with any future uphill expansion stations. The balancing issue would be evident in historical data at those uphill stations already, but the higher net-loss rates should be factored into any future stations.

In Cardiff, Wales, many commuters take the train into the city for work and then check out bikes from the train station to go the last mile to their workplaces. Stations by the train then empty out during the morning rush hour and fill in the evenings. The Cardiff system is quite small in comparison to CaBi, however, as Cardiff only maintains around 150 bikes in their system.

Minneapolis's Nice Ride system is similar in size to CaBi, however their lower usage provides much less of a challenge to rebalance. With 1/3 the number of rentals as CaBi and 1/4 the number of

Mexico City Rebalancing Vehicle
Source: rueda-libre.blogspot.com/ecobici.mexico

annual members, Nice Ride's I.T. Director described their system as having a "lot of excess capacity which makes rebalancing very easy by comparison". To the extent possible, this may indicate that CaBi and other systems will benefit from system expansion, at least in the short term before demand increases to match the new supply.

Balancing Vehicles

From our research, it became evident that various vehicle configurations are being used for system rebalancing purposes. The most common approach involves the use of vehicles with custom built trailers (Barcelona with 30-bike capacity; Denver using two CNG-powered GMC trucks with trailers each with a 24-bike capacity; Mexico City using electric vehicles pulling trailers with a 27-bike capacity; and Minneapolis using two compact pickup trucks with custom trailers). Only one system (Kaohsiung) professed to using large 3.5 ton trucks for their balancing work; however, they are unique in that their maintenance crews also perform the balancing and presumably need maintenance equipment as well. Mexico City also has one 40-bike capacity truck

City	Country	Region	System Name	Number of Bikes	Number of Stations	Number of Annual Members	Operator	Member : Bike Ratio
Barcelona	Spain	Europe	*Bicing*	6,000	420	130,200	Clear Channel	21.7
Cardiff	UK	Europe	*OYBike*	150	20	1,500	OYBike / Veolia Transport	10
Denver	US	North America	*B-Cycle*	510	51	2,600	B-Cycle	5.1
Kaohsiung	Taiwan	Asia	*C-Bike*	500	49	N/A	Kaohsiung Environmental Protection Bureau, & Kaohsiung Rapid Transit Corp.	N/A
Mexico City	Mexico	Latin America	*Ecobici*	1,200	90	34,351	Clear Channel	28.6
Minneapolis	US	North America	*Nice Ride*	1,200	95	3,700	Nice Ride Minnesota	3.1
Paris	France	Europe	*Velib'*	24,400	1,751	210,000	JC Decaux	8.6
Vienna	Austria	Europe	*CityBike Wien*	1,200	84	320,000	Gewista Urban Media, JCDecaux	266.7
Washington, DC	US	North America	*Capital Bikeshare*	1,100	116	18,000	Alta	16.36

City	Avg Ride Time	Average Ride Distance	Membership Types	City Population	City Area (sq. mi.)	Density (per sq. mi.)	System Coverage Type	System Type
Barcelona	20 min (15 min)	1.7 mi (1.5 mi)	Annual	1,621,537	39.3	41416.5	City wide	for profit
Cardiff	N/A	N/A	Annual / Weekly / Daily	341,054	2.6	11,375	City wide	for profit
Denver	N/A	N/A	Annual / Monthly / 7-day / Daily	600,158	154.9	3979.3	Primarily downtown with smaller hubs at popular locations	non profit
Kaohsiung	40 min	6.2 mi	Pay per ride	2,769,072	1137.6	2434	City center and Primary Transit Corridors	public service
Mexico City	20 min	2.8 mi	Annual	8,851,080	573.4	15437.2	City center and Primary Transit Corridors	for profit
Minneapolis	N/A	< 3 mi	Annual / Monthly / Daily	382,578	58.4	6551	Downtown	non profit
Paris	N/A	N/A	Annual / Weekly / Daily	2,211,297	40.7	54300	City wide and surrounding suburbs	for profit
Vienna	22 min	~1.9 mi	One-time registration	1,714,142	160.1	10706.9	City wide	for profit
Washington, DC	N/A	N/A	Annual / Monthly / 3-Day / Daily	601,723	68.3	8810	City wide and neighboring jurisdictions	blend

out of a 12-vehicle fleet. In Paris, only 4% of stations are full/empty. They rebalance 3,000 bikes daily, using 48 dispatchers, 2 buses (carrying 62 bikes each) and 23 trucks (carrying 20 bikes a piece)[14].

No rationale was given for the widespread use of trailers over Sprinter vans, however it is notable that D.C. is the exception to this group. There are obvious urban form considerations that don't allow for easy cross-comparison to D.C., however one could assume certain similarities with Barcelona and Mexico City due to similar population density and urban form characteristics. A further analysis of any potential efficiency gains may need to be made in CaBi's vehicle fleet if they have the opportunity to alter its composition.

It was notable that several systems were looking for alternative fuel vehicles to reduce the environmental impact of their operations. Mexico City is currently running 11 electric vehicles with trailers for their balancing fleet, and Denver's two trucks burn compressed natural gas. Barcelona and Minneapolis both are looking to acquire electric vehicles but have had problems with high cost and limited range capabilities. Given the intensive use of these rebalancing vehicles, the adoption of alternative fuel vehicles may be something that CaBi could consider in the future, particularly as performance improves and costs decline.

Additionally, human power was listed by two systems as a small fraction of their operations. Denver has a bike with 4-bike capacity trailer that they normally use to perform slight rebalances at stations near their warehouse. The smaller size of their system (roughly half the number of bikes that CaBi operates) may make this option more viable. However D.C. may find that during peak congestion such a set-up may actually prove to be more efficient. Minneapolis also uses cargo bikes for minor repair work with the hope of increasing that practice.

Customer Incentives

CaBi stands out as somewhat unique in their use of an incentive driven rebalancing approach. Only two other systems in our case studies used an incentive approach. One was in Cardiff, where they manage only around 150 bikes, but where they offer riders account credit for reverse riding. This credit can then be used in lieu of paying for overage fees if accumulated. The other was in Paris where riders are granted an additional 15 minutes to return bikes to V+ stations which are on hilltops, above a certain elevation. None of the other systems surveyed utilize any methods to incentivize customers to redistribute bikes. The representative from Bicing in Barcelona went as far as to say that they didn't believe customers would be willing to change their travel behavior. Mexico City's representative mentioned that they were considering implementing an incentive similar to what CaBi has offered based on their example, though few other cities hold confidence in the concept. Given traveler constraints and the size of the rebalancing efforts required at scale, customer incentives don't seem to pose any significant help with rebalancing. With that said, the full incremental cost of the incentive program should be compared with the marginal cost of the rebalancing team. It may

Screenshot of a mobile Bikeshare application in Cardiff, UK

make sense to continue the incentive program as a supplement to traditional operations if the ROI is evident. In addition it may be worth looking into the effects of Cardiff's credit program as an enhancement to CaBi's current incentive program.

Denver's B-Cycle system has a pilot program reaching out to low-income riders. This is not intended to be an alternative balancing approach, however we wonder what the impact of increasing the use by individuals with alternative work schedules would be on the system. Further research is needed into the potential balancing benefits by a diversified user base, however there may be balancing benefits in addition to the social justice element.

Tools/Techniques Used

Most bikeshare operators are currently using the same basic tools to inform their balancing and operations. After speaking with Danny Quarrell at Alta Bicycle Share, the tools they have in development would place Alta and Capital Bikeshare at the forefront of technology. At the most basic level, Barcelona described the traditional balancing process as taking place in two parts: the nightly system reset and regular maintenance throughout the day. All of the operators surveyed use software to track station statuses and analyze net station demand. This information is then used to inform balancing operations. Denver uses a proprietary B-Cycle software program while Minneapolis uses the Oliver O'Brien website. The general practice appears to be to use real-time data for tracking purposes and historical check-in and check-out data to formulate a balancing strategy. Few of the systems surveyed used any predictive modeling and most professed to relying on the professional experience of those doing the balancing. The respondent from Minneapolis intended to keep operations decidedly low-tech, to ease staff training. One concern we have with the reliance on professional experience is regarding the potential for staff turnover. Loss of institutional knowledge has the potential to impact system functionality until the new staff member is able to get back up to speed. One solution might be to codify current best practices so that drivers can share what they are doing amongst each other and management can develop a training program.

One area of advanced operations we noticed involved route planning for the balancing vehicles. Time spent in traffic and inefficient routing have the potential to reduce system efficiency and tie up valuable bikes during peak periods when they are most needed. Mexico City has created distribution routes for a regular

14 Velib', 2011

rebalancing schedule based on their analysis of historical travel data. These routes are then optimized according to traffic flow and the urban fabric to ensure optimal efficiency for their balancing operations. The Kaohsiung system in Taiwan also reported route planning for their repairmen/balancing crew to minimize the time they spent in traffic congestion.

Lessons learned

The representative from ClearChannel we spoke with in Barcelona had four years of experience working with numerous systems and stressed the importance of managing a balance between "system capacity and the subscribers you accept." It is important to note that Barcelona's system is operated by ClearChannel who has a stake in generating advertising revenue as compared to some of the other hybrid public/private partnerships or pure non-profit structures (as in Minneapolis and Denver). Elements of this can be seen in the CaBi Living Social offer, where a large number of annual members were brought on in a very short period of time, resulting in increased balancing problems. The sales and marketing function have a direct impact on system operations, specifically balancing. Where these roles are not housed within the same organization, some effort needs to be made to coordinate their efforts.

2. Operation, Maintenance, and Warehouse Procedures

a. The Warehouse

Bike sharing systems generally require a warehouse for their operation, maintenance and storage needs. Aside from Barcelona's two warehouses, all of the other systems surveyed have only one location which varies depending on the area of operation. The location of the warehouse seems to be a rather important point for bikeshare systems to consider before they start or expand their operation.

Mexico City, for example, located their single warehouse based on the radius of the zone of operation and placed it in a strategic area with easy access to all stations. This tactic facilitates the most efficient organization of maintenance routes. CaBi, on the other hand, operates a single warehouse in a light-industrial section of the city, closer to the downtown core than to outlying stations in the system. This placement complicates balancing during the morning peak, as rebalancing vehicles must traverse the downtown core to reach stations demanding more bicycles. Location strategy is something that CaBi may have to consider in the future after conducting an in-depth analysis of the benefits and drawbacks to their operation.

Locations also vary depending on the system's operation months. Bikeshare systems that do not operate all year long store their bikes in several locations. Denver uses their warehouse to store a small number of bikes during their operating months, but during the winter season they use a remote warehouse to store the system components for the off-season. Minneapolis is currently looking to consolidate their warehouse and office space

in one location. Over the winter, they are planning to store their equipment in an unused building. Given that CaBi operates year-round, the larger storage facility is not needed. Satellite storage or maintenance locations may become a consideration, especially as the system continues to expand in Northern Virginia and Montgomery County.

b. Identification Methods

CaBi users report damaged bicycles by pressing a maintenance call button located on each bicycle dock. CaBi has encouraged members to turn the saddle backwards to provide a cue to other users that the bicycle is out of service, and a recent dock enhancement leaves a red light illuminated at docks with a maintenance-locked bicycle. Rebalancing crews perform a diagnostic check of locked bicycles when they service a station. Either they tag the bicycle (and turn the saddle backwards) for field repair if appropriate, or take the bicycle out of service to return to the warehouse.

Minneapolis's identification system is similar to that used by CaBi. Each dock has a button that can be used to tag bikes in need of repair. According to a representative from Bicing in Barcelona, the system blocks a bike after three people have returned it or reported it damaged. Subsequently, their technicians take those bikes back to their warehouse for repair. Vienna employs two methods to identify damaged bikes: 1) users can report it through the station, and 2) via a team of mobile workmen who inspect each bike in the fleet. This team is able to perform most of the repairs at the station, reducing the balancing load by not having to ferry bikes to and from the repair facility. Depending on the actual load this represents to the CaBi balancers, there may or may not be efficiencies gained in the future from implementing a similar mobile repair service. This may be worthy of future analysis, particularly as additional stations are added in Northern Virginia and Montgomery County.

c. Maintenance and Repairs

All systems scheduled regular maintenance to their bicycles. CaBi maintenance intervals are dictated by contract and bicycles are tracked by serial number for easy identification of those due for maintenance. Denver uses a different method, they separate all of their bikes into four groups to be tuned up every three weeks on a rotating schedule. Mexico City performs daily maintenance in two ways: one is preventive – performed during the balancing at each station (inflating the tires, adjusting the brakes, seat adjustment, etc.) while the second is the extensive maintenance done at their warehouse when a damaged bike cannot be repaired at the station.

Similar to Mexico City, Barcelona's technicians are in charge of taking the damaged bikes out of the system when repairs cannot be made on-site, though they also pick up the bikes that have been blocked by the system. In Kaohsiung, the repairmen are the ones responsible for balancing the system and do so as part of their daily maintenance process. CaBi minor service checks and

simple field maintenance tasks are performed by a cargo-bike mounted mechanic team. CaBi bicycles due for major maintenance or repair are pulled out of the system and taken to their warehouse. All maintenance and nearly all new bicycle builds are performed by in-house mechanic staff.

For all bikeshare systems, the amount of time bikes spend at the shop varies depending on the type of maintenance. The representative from Mexico City mentioned that their bikes rarely stay at the shop more than 24 hours. CaBi staff did not provide a precise turnover time for warehouse maintenance, but they indicated that the volume of bicycles in the warehouse for maintenance, along with newly built bicycles awaiting deployment, causes significant space issues. Minneapolis has a contract with a local bike shop to do approximately 90% of the repair work on the bikes. All but the simplest of repairs are handled by them. As soon as the bikes have been repaired, the bikes are picked up by one of the bikeshare system's trucks and are back on the streets.

For most systems, keeping both stations and bikes in good condition, not just mechanically but also visually, is important. In Vienna, workmen who visit the stations several times a week for maintenance also take care of the visual appearance of the bicycles and stations. Graffiti, stickers, etc. are removed as quickly as possible which in turn keeps these incidents low in the first place.

3. Internal Business Operations:

Revenues, IT, monitoring internal business operations include head-office activities like revenue collection, information technology, and system monitoring. By and large, the systems that we surveyed were broadly similar to CaBi in their business models. The key distinctions principally relate to the advertising-supported business model prevalent in Europe versus the more self-funded model more common in North America. A few systems have made some innovations, particularly with regards to using IT to track and direct system operations.

a. CaBi

CaBi uses a software program called "CaBiTracker" in its operations. CaBiTracker provides real-time information to rebalancing drivers on how many bikes and docks remain at stations. CaBiTracker is limited to system status and does not provide any insight on how far stations are from a theoretically optimum stocking level, nor does it prioritize which stations need to be visited.

CaBi's software contractor is working on a map-based program that will display how far each station is deviating from its ideal bike and dock stock level for a given time of day, along with real-time traffic conditions and GPS tracking of truck location. This new software capability would allow a dispatcher to direct rebalancing drivers to stations based on identified need, and advise them on traffic conditions to improve routing. Rebalanc-

ing productivity can be improved, through improved decision making on rebalancing, relieving drivers of system monitoring, better ability to react to changing conditions, and the availability of traffic information for better routing decisions.

Revenues for CaBi are collected by Alta Bicycle Share on behalf of the city governments. CaBi operations are provided by Alta Bicycle Share, via a fixed-price contract with performance penalties for service. Revenues to date have been sufficient to fully-fund operations. Short-term users make an outsized contribution to CaBi finances.

b. Peer Systems

Most systems tracked capital-related metrics (bicycles in fleet and rental points/stations) as well as ridership as their primary performance metrics.

Not all systems allow casual (short-term) users to access the system; Barcelona and Mexico City are notable examples in this regard. Vienna, on the other hand, allows anyone with a credit card to access the system for an access fee of only €1. All of those systems are operated by outdoor advertising companies, so other revenue is available to fill the resulting funding shortfall.

All systems surveyed had pricing schemes oriented to encourage short, one-way trips. Generally, systems operated by advertising vendors kept usage fees lower and price schedules simpler. Typically, ad-supported European systems have lower fees overall – e.g., allowing free or low-cost rides for as long as two hours (in Barcelona). Despite this different structure, the average rider's elapsed time and distance do not appreciably differ between cities.

System-generated revenue was not forecast to cover all operating costs in any European system that we surveyed; Barcelona's system only recovers 25% of its costs via system revenues. However, most European systems operate on a concession model, where the right to sell or place public advertising takes the place of revenue, making calculation of cost recovery impossible. JCDecaux operates on this business model, contracting with cities to operate their bikeshare system in exchange for the right to sell advertising space on street furniture throughout the city. The breakdown of revenues varies by city, depending on each city's advertising potential. For example, in Lyon, subscription fees are paid to JCDecaux, while all other revenue goes to the city. In Marseille, its only user fees that go to the operator. However, in Paris, all revenue from the system is paid directly to the city and JCDecaux has incentives and penalties written into their contract for exceeding or failing to meet established criteria. By contrast, Denver B-Cycle operations are self-sustaining from system-generated revenue, and Minneapolis hopes to achieve a similar degree of self-sufficiency.

Expansions are funded differently. In Denver, sponsors and grants underwrite expansion. In most other cities, funds for expansion appear to come from either local government, the sponsoring outdoor advertising vendor, or grants (in the United States).

Most systems used a centralized computer platform that allows

real-time tracking of how many bicycles are at any given station via maps, and use this data to direct rebalancing operations. In Denver, the proprietary system also generates alerts; in Kaohsiung, the system actively rebalances prior to weekends and holidays.

Paris has just recently taken an additional step and, in coordination with a doctoral engineering student, begun developing computer models of their system. The model incorporates all prior bicycle movements, across both space and time. The model goes beyond the station's current status to classify stations as "structurally" full or empty, or one that will self-balance if given enough time. This model is particularly useful for understanding and identifying less-obvious flows that may unfold over time periods longer than an hour. For example, a popular restaurant area will attract diners throughout the evening, many of whom will expect to find bikes where they left them earlier. Such flows may have escaped notice under the earlier system, which principally took employment and elevation into account. Thanks to the model, dispatchers can direct rebalancing vehicles to swap bikes between matched pairs of nearby full/empty stations, and leave other stations to sort themselves out.

All systems that we surveyed relied on stations, not bicycles, to report data back to the system, typically connecting the stations to the central office through conventional mobile-phone networks. This can lead to occasional communications problems when those networks are overburdened -- as may happen during large events. B-Cycle also incorporates GPS receivers on the bicycles, which are used to report data back to users. Since B-Cycle also encourages round-trip rides (e.g. its bicycles have locks), GPS tracks from individual bicycles could also indicate locations that riders are frequenting and thus could be suitable future station locations.

4. Marketing and Station Siting

a. CaBi

Capital Bikeshare's marketing, sales, customer service, and fulfillment are all handled by a direct contractor to the city, under the umbrella of a transportation demand management program called goDCgo. This contractor does not target marketing by area, instead promoting transportation services on a citywide basis. In spring 2011, a sales promotion run through the LivingSocial coupon website was wildly successful at attracting many new users, perhaps too many from the operator's perspective.

All advertising, sponsorship, and any other ancillary revenues generated by CaBi go to its sponsoring governments; SmartBikeDC, CaBi's predecessor, directed such revenues to the advertising vendor. All membership and usage revenue also goes to the sponsoring governments, and they adjust system prices by consensus. CaBi attempts to maximize ridership as a primary goal, rather than maximize revenue. Sponsorship revenue is currently being sought, but the use of station kiosks for third-party advertising (as is common in European systems) is barred by the rules of the Federal transportation funding used for CaBi's capital expenditures.

CaBi's station siting is factored in expected ridership demand. Government planners use a variety of variables to prioritize potential station sites These include nearby employment, population density, existing bicycle mode share, and nearby destinations. Now that there is a body of usage data and an established user base to draw upon, station siting can take into account demonstrated ridership demand along with public input through crowdsourcing tools. Local politics in Washington resulted in a decision to roll out initial service across all eight wards of the city, in contrast with the clustered deployment and expansion approach taken in Arlington, and the planned deployments in Alexandria and Rockville.

Limited cooperative marketing efforts have been pursued, with several area bicycle shops offering discounts on helmets to members, and businesses distributed free 24-hour membership vouchers. A few examples of CaBi cooperatively promoting new stations with adjacent businesses were noted, but it does not appear to be a standard practice for the program.

CaBi has attempted a number of promotions to encourage ridership. A "Winter Warrior" contest to encourage ridership through the system's first winter season was considered a success, but a reverse rider incentive program was not. CaBi-specific events, such as group rides and public parties, are not an apparent part of the marketing strategy, with the exception of the system's first-anniversary party.

b. Peer Systems

Marketing strategies vary widely across a number of the systems reviewed and are most often a result of the type of bikeshare system established – whether run as a business or a public service; or whether the principal goal of the operator is to increase ridership or generate revenue. Marketing is the most direct method that bikeshare systems have to communicate ideas, intent, and information to both current and potential clients and users. The different bikeshare systems reviewed used several key methods to coordinate their marketing strategies with their business/operations model.

All bikeshare systems use the station kiosks and the design of the bicycles to broadcast information on the quality and identity of the system. Still other systems partner with local businesses to create ridership incentives and some run lottery programs to entice new riders.

Station siting and the design of kiosks and bikes are critical not only to bikeshare operations, but also to brand identity and to relay information. All of the systems reviewed have an interactive kiosk display for purchasing passes or viewing system status. The redesigned kiosk in Paris displays an interactive map showing station balance at 10 nearby stations, and when not in use shows a screensaver with helpful user hints.

Ads on bikes and stations

Many of the bikeshare systems reviewed incorporate advertising strategies very closely with their general operational strategies. Typically the systems that do so are in part owned or operated by large advertising or media firms. Vienna's CityBike does so more than most, providing ample space on both stations and bikes for prospective advertisements. The flat space on the front basket, the front and rear wheels, and the rear fender serve to broadcast advertisements to anyone passing one of the bikes on the street. Since Vienna's CityBike is operated by Gewista (of which JCDecaux is majority shareholder), ad revenue is a primary means of covering operational costs, thus an extensive ad campaign makes sense.

Systems like Denver and Minneapolis on the other hand, are not owned or operated by media firms, but still believe that partnerships with businesses are important. Denver's B-Cycle specifically offers single and multi-year sponsorship opportunities at their stations for corporate and small business partners. Part of the sponsorship includes prominent display of the participating company's logo on the permanent station kiosk and on a select number of bicycles that travel across the city as they are rented.

Still other systems purposefully avoid advertisements on the sides of stations and bikes, leaving only room for their own logos such as Barcelona's Bicing, or blank space with potential for future advertisements such as Kaohsiung's C-bike. Both systems have the space for advertisements on their bikes – they operate similar designs and styles of bicycles to Vienna's CityBike – yet they choose not to utilize their space in such a way. In addition, both Barcelona and Kaohsiung use station interface kiosks that are much slimmer than those used by other reviewed systems, leaving enough space for city maps without advertisements.

Partnerships with Local Businesses

Multiple bikeshare systems reviewed engage in marketing techniques where they partner with local businesses for the mutual benefit of all participants. Some systems, like Vienna's CityBike, have offered members deals at nearby businesses. When the station at Markthalle Alsergrund was set to open, CityBike partnered with Cafe Blue-Orange, located on the same street corner as the station, to offer free cups of coffee to the first fifty users. This encouraged bikeshare members to visit the expansion station while at the same time giving publicity to a city business in the area.

Systems like Denver's B-Cycle and Minneapolis's Nice Ride take a more city-wide approach. Denver's system partners with businesses in the area to provide discounts and special deals for anyone with a B-Cycle membership card. For example, showing a B-Cycle card will get a user a 50% discount to museums in the Denver area, 10% off purchases at specific coffee shops, 10% off wine at some local package stores, and even 50% off one's first month of rent at a nearby co-working office building, to name just a few. Likewise, yearly subscribers to Minneapolis's Nice Ride receive a book of coupons in the mail annually with discounts

towards businesses in the area. While most discounts that come with a Nice Ride membership are one-time coupons, the B-Cycle discounts apply to every purchase.

In addition to partnering with local businesses, Minneapolis's Nice Ride partners with certain universities in the Twin Cities area. For example, Augsburg College, located in downtown Minneapolis, has worked alongside Nice Ride in order to establish a bikeshare station on campus as well as several other locations nearby and specifically markets ridership to new students in their welcome packets. Nice Ride also offers a discounted annual membership price to students.

Targeted Users

Of the bikeshare systems who responded to this study, only one, Cardiff, currently targets its marketing strategy to aid in the rebalancing efforts to any extended level. However, the system is quite small in comparison to most other systems and the effect of the strategy may not translate effectively. Mexico City's EcoBici, is currently evaluating a system for rewarding riders who travel against the prevailing travel currents during peak hours. Several systems, including Vienna's CityBike and Barcelona's Bicing, have attempted targeted marketing strategies aimed at assisting with balancing issues in the past but with extremely limited or no success. On the other hand, Paris reports seeing a real impact from its "V+" system, which grants 15 minutes of additional free time to riders taking a bike from a flatland station to a station uphill. Riders are free to use the 15 minutes on that particular ride or on a subsequent ride.

Many of the reviewed bikeshare systems have marketing strategies in place to target specific demographics. Barcelona's Bicing stands out as fairly unique in this sense, targeting only local residents. Because Bicing offers no short-term memberships – and because a local address is required to purchase an annual membership – only local residents can join the system. As a result, Bicing has a much more narrow marketing range than other systems that cater to both residents and visitors. Changes to the system or announcements that need to reach users are a relatively simple and direct matter – the system has the email addresses and phone numbers of all members. Overall, Bicing states that the primary task of its marketing venture is to "manage expectations" by communicating current system functionality and upcoming changes months in advance.

Unlike Barcelona, Vienna's CityBike has specifically created a system for encouraging tourists and temporary visitors to use the bikeshare system. The CityBike Tourist card can be purchased online and gives a user full access to the system for a flat fee per calendar day. The user can even select a period of days, consecutive or not, beforehand, to simplify payment.

Both Denver and Minneapolis attempt to engage lower-income constituents with specific bikeshare membership offers. The low-income program in Denver was made possible by a grant from a local NGO that provides the financial security to allow low-income residents to sign-up for the program at a subsidized rate

and without need for a credit card. The program has been only somewhat successful in its first year, reaching slightly less than half the number of low-income riders it had funding for. Denver plans to hire a marketing firm to assist in outreach to low-income communities for the upcoming season.

Kaohsiung's C-Bike, in addition to marketing to residents and tourists also takes the step of marketing specifically to recreational users of the bikeshare system. Alongside the establishment of C-Bike, Kaohsiung has built many kilometers of bike paths, several of which meander through the national parks and beachfronts of the Taiwanese city. In part because Kaohsiung's C-Bike is run through a partnership with the city's Environmental Protection Bureau, much of C-Bike's general marketing strategy is geared towards showcasing the city's green infrastructure and natural scenery. Specific goals of Kaohsiung's marketing campaign are to increase ridership to a level where each bike is used an average of twice daily.

Contests and Rewards

Several of the systems reviewed arrange fun activities or giveaways to provide their users with more than just the standard uses of the bikeshare systems. Denver's B-Cycle sponsors group rides where users can rent a bike and ride around the city with local celebrities. Past rides have included guests such as the mayor of Denver, local NFL players and local news anchors. Recently, B-Cycle hosted a giveaway where the most frequent rider received a 2-day, 2-night skiing trip for two in nearby Aspen, Colorado.

In Cardiff, OYBike teamed up with the "Cardiff Cycle Challenge", an initiative sponsored by the city along with a number of organizations, to encourage residents of Cardiff to bike to work. Over the three week period of the challenge, OYBike offered annual memberships for only £1.

Kaohsiung's C-bike hopes to encourage healthier living within the city through a series of hosted Green Bike Tours as part of the local government's broad city greening initiative. C-bike members, and those with their own bikes, are invited to ride across the city in groups alongside city government officials in a push to encourage a healthier citizenry. Participants are entered into a lottery and have a chance to win small token prizes from C-Bike such as fabric patches with the system's logo, or special gold membership cards.

Online Marketing – Websites and Social Media

Of the several bikeshare systems reviewed, it appears common to have an organized and concerted online marketing effort; all systems make some use of the internet, often from a wide variety of angles. Users and fans of any system can subscribe to its Facebook and Twitter posts as well as system blogs and newsfeeds. The various platforms keep members up-to-date on current events with the system and announce sponsored rides, station outages, system expansions, and other relevant informa-

tion, often sharing more (or different) information than what is found in typically less frequent email blasts.

Minneapolis takes online marketing to a different level with NiceRide's venture into online merchandising. A direct link provided at the top of the NiceRide website's menu directs browsers to a page where they can purchase a number of items embroidered with the NiceRide logo, including shirts, socks, hats and gift cards.

The website run by Kaohsiung's C-Bike, aside from advertising the qualities and membership offers of its bikeshare program, also acts as an advertisement for the entire city, highlighting its growing level of cycling enthusiasm. The C-Bike online portal readily links to the websites of a number of local cycling enthusiasts and bike clubs.

Station Siting

1. Vienna - Stations are sited widely across the city. The system website offers street-view photographs of each station to aid in user familiarity with area.

2. Barcelona - Stations are sited widely across the city. Focus is placed on siting stations in both residential and business hubs.

3. Kaohsiung - Most stations are located in the city center and along primary transit corridors leading in and out of the city. Many stations are purposefully located near KRTC Metro transit stops also capable of selling bikeshare memberships.

4. Mexico City - Most stations are located in the city center and along primary arterial roads leading to the city center.

5. Denver - Stations are primarily located within the downtown area of the city or where the bikeshare system can team with businesses to sponsor station locations. Smaller clusters of roughly four or five stations geographically separated from the primary downtown hub have been established in other, popular parts of the city; currently at a large shopping center and the University of Denver. System is currently exploring means to provide station access in low-income neighborhoods.

6. Minneapolis - Stations are primarily located within the downtown area of the city or where bikeshare system can team with businesses to sponsor station locations. Several stations located near the university with some on campus.

7. Paris - Stations are located across the entire city from center to outskirts. Station locations are advertised at a distance of no more than 300 meters between stations.

C. Conclusions and Lessons Learned

In conclusion, CaBi's internal business operations appear to have much in common with its peer systems worldwide, particularly since its hardware incorporates many of the same features that other systems have. Our findings indicate that in many respects, CaBi is already at the leading edge of the industry in maximizing ridership with an existing asset base of bicycles and docks.

Rebalancing will have to become more technologically sophisti-

cated in order to proactively address shortages, to the maximum extent that those shortages can reasonably be addressed by operations. The new software in the works that predicts short-term future station loads sounds similar to software features that are already implemented in several other cities.

That platform should be built upon with additional route optimization software -- similar to Mexico City's -- that sends trucks on the most efficient routes based on traffic patterns and also possibly known traffic disruptions. These databases also should attempt to capture staffers' on-the-job knowledge. We feel that CaBi puts its operational efficiency at risk by relying solely on the intuition and knowledge of drivers. Codifying efficient routing, creating a system that proactively manages system operations, and having a dispatcher to direct how the systems operations are carried out would all ensure continued operational excellence in the event of staff turnover.

Computer modeling of bicycle movement has only been attempted by one system (Paris) and only very recently. They report that it is no substitute for intuition, but has informed their rebalancing routes. As these models continue to incorporate additional data points, they will improve in utility. Future extensions of the models might also incorporate other variables, such as holiday weekends, weather forecasts, and planned transit disruptions, to predict how these affect demand. Academic researchers have applied the principles of logistics modeling to the problem of bikeshare system rebalancing (Raviv et al, 2011).

Interestingly, the differing price schedules that exist do not seem to affect rider behavior quite as much as one might expect. Reaching break-even on operations will allow CaBi to continue to direct new resources towards system expansion and enhancement, which should allow for greater operating efficiencies (through scale or investments). CaBi should continue to experiment with prices, but always strive to present that information in an easy-to-grasp way.

More warehouse and repair facilities will be needed to maintain bicycle fleet reliability, particularly as the system extends further outward from the current Half Street location. The high price and scarcity of light-industrial real estate in CaBi's peak usage areas are significant obstacles. However, CaBi should strive to locate satellite facilities in areas easily accessible to peak usage areas, to allow for quick access to high-traffic stations. CaBi should also consider establishing formal contractual relationships with area bicycle retailers, especially those located near peak usage areas. These maintenance contractors would remove bicycles specified by CaBi operations from the system, perform necessary maintenance, and return them to service at peak stations at peak times.

CaBi should concentrate and incentivize membership sales and marketing to under-served and counter-peak station areas. For-profit systems, and those that have an integrated marketing and operations organization, have the organizational incentive to pursue customers in areas where the system is operating short of peak capacity. CaBi, with its separate marketing and operations organizations, can embrace a program priority on directing

sales attention on low-ridership regions. Continuing with general system promotion and awareness marketing only exacerbates operational problems in peak areas/times, while not developing low-ridership areas.

CaBi should also continue experimenting with promotions and incentives to encourage system balance. While the results of such measures have not been effective to date, and only the Paris case study (adding additional time credits for counter-peak trips) was found to inform future efforts, these promotions also serve the useful purpose of signalling to users in a positive way that the existing system cannot accommodate all peak-period demand. Because CaBi stakeholders share the goal of maximizing ridership over revenue, enacting additional fees and charges to constrain demand is not recommended at this time.

Ridership can also be maximized without impairing operations by finding new riders at off-peak times, such as weekends. Besides the weekend tourist traffic targeted effectively in the Kaohsiung system, area residents who only want to use CaBi on weekends may be a worthwhile sales target. Offering a heavily discounted weekend-only membership fob could attract new area residents who would add rides with less disruption to system balance, while also minimizing the number of riders who have to interact with the station kiosk.

All parties in the CaBi system need to determine the true peak demand at the busiest stations. At some point, devoting more attention to operations delivers diminishing returns, and becomes a poor substitute for installing more capacity. Alta proposed a novel idea for assessing the true demand for stations - conduct a "bottomless station" experiment, where peak traffic stations are continuously (and covertly) restocked and emptied by CaBi staff. Conducting such an experiment would allow for a precise solution to service failures at peak stations. Other ideas for identifying latent demand include a Spotcycle function and/or a function integrated into the CaBi dock to allow users to indicate when they are left without a bike at an empty station, and analyzing spatial patterns of existing Facebook and Twitter input.

True demand may outstrip both the capacity of the existing hardware, and the ability of existing operations to service the stations. In this case, the CaBi parties need empirical data to identify where additional capacity is needed. Where lack of capital funds, scarcity of street space, or other obstacles preclude the installation of additional docks, the parties may examine targeted enhanced operations in corridors, over and above those required by the current contract requirement for no more than three hours of a full/empty dock. These enhanced operations corridors might feature devoted rebalancing vehicles, routine "bottomless station" operations, and special designation within the system for customers. CaBi can conduct these enhanced operations knowing that it will result in additional ridership. Rationally, such enhanced operations should not exceed the costs of capital expansion, but with the obstacles and lead time necessary to install new stations, and CaBi's high level of operational cost recovery to date, such an investment in short term

enhanced operations would help preserve membership loyalty, boost ridership, and boost CaBi's return on assets.

A significant finding was that many worldwide systems use open trailers and trucks for redistribution, in contrast to CaBi's enclosed Sprinter vans. While trailers may be difficult to navigate through rush-hour Washington traffic, a human-factors analysis would likely reveal significant time savings in loading and unloading. Additionally, a detachable trailer may allow for advance morning staging of additional bicycles to peak areas.

It is recommended that CaBi perform an experiment (timing loading and unloading from walled and open-walled vehicles) to see if significant time savings result from the use of open-walled vehicles. If so, these time savings could justify the expense of commissioning open-walled vehicles. Additionally, if CaBi pursues the enhanced operations corridor strategy, these corridors could be plotted to allow for the use of trailers.

Alternative fuel and even human-powered redistribution vehicles are deployed elsewhere, and especially if operations are used to substitute for additional capacity, it is important that CaBi ensure that it minimize its environmental impact. The CaBi system is expanding regionally, and will soon feature many diverse levels of ridership, dissimilar station densities, and the possible establishment of smaller remote warehouses. CaBi should purchase and operate a varied fleet of redistribution vehicles, with the goal of deploying the lowest impact vehicle necessary to adequately service a particular node of the system.

VI. Bibliography

Buehler, R., Hamre, A., Sonenklar, D., & Goger, P. (2011). Trends and Determinants of Cycling in the Washington, DC Region. Washington: Mid-Atlantic University Transportation Center (MAUTC), Research and Innovatione Technology Administration (RITA), United States Department of Transportation (DOT).

Capital Bikeshare. (2010). Capital Bikeshare Customer Survey. Washington: District of Columbia Department of Transportation, Arlington County.

Capital Bikeshare. (2011, October 11). Expansion Update in the District and Arlington County. Retrieved November 28, 2011, from Capital Bikeshare: News: http://capitalbikeshare.com/news/?p=1037
Capital Bikeshare. (2011, July 15). DDOT and Capital Bikeshare Launch Pilot Program with Kimpton Hotels to Promote Safe Bicycling to Visitors. Retrieved November 28, 2011, from Capital Bikeshare: News: http://www.dc.gov/DC/DDOT/About+DDOT/News+Room/DDOT+and+Capital+Bikeshare+Launch+Pilot+Program+with+Kimpton+Hotels+to+Promote+Safe+Bicycling+to+Visitors

Destination D.C. (2010). Washington DC's 2009 Visitor Statistics. Retrieved November 28, 2011, from Destination D.C.: Research and Statistics: http://washington.org/images/marketing/2009_Visitor%20Statistics_FINAL.pdf

Insititutional Review Board (IRB), Virginia Tech (2011). Accessed at http://www.irb.vt.edu/pages/about.htm.

OBIS (2011, June). Optimizing Bike Sharing in European Cites: A Handbook. Retrieved October 17, 2011, from OBIS website: http://www.obisproject.com/palio/html.wmedia?_Instance=obis&_Connector=data&_ID=779&_CheckSum=1882085425

Raviv, T., Tzur, M., and Forma, I. (2011, August). Static Repositioning in a Bike-Sharing System: Models and Solution Approaches. Tel Aviv University, Tel Aviv.

Sullivan, P. (2011, October 11). Alexandria Joins Capital Bikeshare. Retrieved November 28, 2011, from Washington Post: http://www.washingtonpost.com/local/alexandria-to-join-capital-bikeshare/2011/10/11/gIQA4OOudL_story.html

U.S. Census Bureau. (2011). United States Census, 2010. Washington: United States Department of Commerce.

Velib' (2011). La Régulation, Succès et Ambitions. Velib' & Moi blog. Retrieved November 18, 2011, from http://blog.velib.paris.fr/blog/velib-et-vous/la-regulation-succes-et-ambitions/

VII. Appendix 1

CABI CASUAL USER: DOMESTIC TOURIST

Our Top Users By State Rank	State	# of Users	% Individual States	% Cumulative	On Destination DC Top 14 List?
1	NY	24	12.97%	12.97%	YES
2	VA	21	11.35%	24.32%	YES
3	CA	15	8.11%	32.43%	YES
4	TX	13	7.03%	39.46%	YES
5	IL	12	6.49%	45.95%	YES
6	CT	11	5.95%	51.89%	NO
7	MA	10	5.41%	57.3%	YES
8	NJ	9	4.86%	62.16%	YES
9	GA	8	4.32%	66.49%	YES
10	NC	7	3.78%	70.27%	YES
11	FL	6	3.24%	73.51%	YES
12	PA	6	3.24%	76.76%	YES
13	OH	5	2.7%	79.46%	YES
14	AZ	4	2.16%	81.62%	NO
15	MD	4	2.16%	83.78%	YES
16	CO	3	1.62%	85.41%	NO
17	MN	3	1.62%	87.03%	NO
18	UT	3	1.62%	88.65%	NO
19	WA	3	1.62%	90.27%	NO
20	AK	2	1.08%	91.35%	NO
21	KS	2	1.08%	92.43%	NO
22	LA	2	1.08%	93.51%	NO
23	MI	2	1.08%	94.59%	YES
24	OR	2	1.08%	95.68%	NO
25	DE	1	0.54%	96.22%	NO
26	HI	1	0.54%	96.76%	NO
27	IA	1	0.54%	97.3%	NO
28	KY	1	0.54%	97.84%	NO
29	NE	1	0.54%	98.38%	NO
30	NH	1	0.54%	98.92%	NO
31	TN	1	0.54%	99.46%	NO
32	WI	1	0.54%	100%	NO
		185			

VII. Appendix 2

Country	City	System Name	Annual Members	Bikes / Docks / Stations	Member:Bike Ratio	Dock:Bike Ratio	Operator
Australia	Brisbane	CityCycle	7,000	1,000 / N/A / 108	7	N/A	JCDecaux
Austria	Vienna	CityBike Wien	320,000	1,200 / 1,899 / 84	266.7	1.58	Gewista (JCDecaux)
Brazil	Rio de Janeiro	SAMBA	N/A	60 / N/A / 19	N/A	N/A	Mobilicidade
Canada	Montreal	Bixi Montreal	N/A	5,050 / N/A / 405	N/A	N/A	Bixi
China	Hangzhou	HZ-Bike	N/A	60,600 / N/A / 2,416	N/A	N/A	Hangzhou Public Bicycle Transport Service
England	London	Barclays Cycle Hire	128,000	6,000 / 9,517 / 400	21.3	1.59	Barclays
France	Paris	Vélib'	210,000	24,400 / N/A / 1,751	8.6	N/A	JCDecaux
France	Lyon	Vélo'v	42,000	4,000 / N/A / 350	10.5	N/A	JCDecaux
France	Bordeaux	VCUB	N/A	1,545 / 2,634 / 139	N/A	1.7	Keolis
France	Rennes	LE vélo STAR	N/A	900 / 1,697 / 83	N/A	1.89	Clear Channel
Germany	Munich	Nextbike	N/A	300 / N/A / 30	N/A	N/A	Nextbike
Germany	Hamburg	StadtRad	33,000	1,000 / 1,500 / 72	33	1.5	Call a Bike
Ireland	Dublin	dublinbikes	58,000	600 / N/A / 44	96.7	N/A	JC Decaux
Israel	Tel Aviv	Tel-O-Fun or Tel-Ofan	4,000	1,500 / 2,305 / 150	2.7	1.54	FSM
Italy	Milan	BikeMi	N/A	1,300 / 2,818 / 120	N/A	2.17	Clear Channel
Mexico	Mexico City	Ecobici	34,351	1,200 / 2,336 / 90	28.6	1.95	Clear Channel
Norway	Oslo	Oslo Bysykkel	N/A	1,200/ N/A / 100	N/A	N/A	Clear Channel
Spain	Barcelona	Bicing or 'El Bicing'	130,200	6,000 / 11,900 / 420	21.7	1.87	Clear Channel
Spain	Seville	Sevici	62,700	2,500 / 4,500 / 250	25.1	1.8	JC Decaux
U.S.	Denver	Denver B-Cycle	2,600	510 / 702 / 51	5.1	1.38	B-Cycle / Denver Bike Sharing

VII. Appendix 3a: Responses

Case Study Questionnaire & Survey Responses
Vienna Response:

1. Wieviele Fahrraeder hat Ihr Bike Sharing System? How many bikes do you have available?
1200

2. Wieviele Mitglieder hat Ihr Bike Sharing System? How many total members do you have?
Over 320.000 registered users (accumulated since the start of the system in 2003)

3. Wieviel Ausleihstationen fuer Fahrraeder hat Ihr System? How many stations do you have available?
Right now 84. We're in the middle of expanding the system - the city of Vienna is funding an expansion to 120 stations.

4. Wieviele 'Ausleihvorgaenge' gibt es bei Ihnen pro Jahr oder Monat? How many have a daily or short-term membership?
At the moment we're having over 500.000 rentals in the last 12 months, with up to more than 75.000 rentals in our top months during summer.

5. Wie werden Fahrraeder zur Reparatur identifiziert, aus dem System entfernt und dann wieder eingefuehrt? How are bikes taken out of and reintroduced into the system for maintenance?
There are 2 systems for identification of damaged bikes. The users can report damaged bikes through our terminals (the unit at every station where you make the rental). And we have technicians on the street that go from station to station checking the bikes. Most of the damages are minor and can be repaired directly at the station, otherwise the bikes are transported to our workshop.

6. Haben Sie eine zentrale Reparaturstelle oder ein System von Reparaturstellen? Do you have one general warehouse or a system of warehouses for storing bicycles?
We have one central workshop, but as mentioned above the vast majority of repairs is done on the street.

7. Wie lange wird ein Rad im durchschnitt geliehen? What is the average time per ride?
The average rental lasts 22 minutes, with the most common rental lasting 10 minutes.

8. Welche Distanz legt ein Rad im Durchschnitt pro Ausleihvorgang zurueck? What is the average distance traveled per ride?
We don't directly measure this but base our numbers on statistical estimations. The average length is about 3 km, but the most common is less than 2 km.

9. Welche Arten von Mitgliedschaft gibt es bei Ihnen (Jahres, Monats, Tagesmitgliedschaften)? What types of memberships do you offer?
With Citybike Wien you only need to register once (per card you're using), there is no limitation on duration. There's also a one-time-only registration fee of EUR 1.00 and no further recurring costs other than possible ride fees.

10. Wieviele Langzeitnutzer (Jahresmitglied) und wieviel Kurzzeitnutzer (Tagesmitgleid) gibt es bei Ihnen? How many have an annual membership? How many have a daily or short-term membership?
Not applicable, see above.

11. Hier in Washington, DC gibt es oft die Situation, dass einige Stationen leer (kein Fahrrad kann ausgeliehen werden) oder voll sind (kein Fahrrad kann abgegeben werden). Kommt das bei Ihnen auch vor? Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
Yes, and I'd believe this will be the case in most if not all bike systems that are used - the main causes being size limitations of the stations, natural traffic streams (e.g. at night more people want to ride out of the inner city than into) and geographical factors (e.g. less people will ride up a hill than down).

Wie gleichen Sie solche Ungleichverteilungen im System aus? Wie stellen Sie fest, dass einige Stationen voll oder leer sind? Wie lange muessen Stationen leer oder voll sein, bevor Sie einschreiten?
We move bikes from full to empty stations on a regular (daily) basis. This is based for one on experience and long-term evaluation (so we know when stations will be full/empty, and if stations will regulate themselves (some stations will change from full to empty and back again simply by shifting traffic over a day)). Furthermore, both the office as well as the technicians have access to overviews of the system displaying the "fill state" of each station to be able to react accordingly.

12. Koennen Sie Ihre Betriebskosten durch Verleiheinnahmen vollkommen decken? Do your revenues cover all of the costs of operating the public bicycle system?
Our hiring rates are geared to generate lots of short bike rides, with the first hour of each ride being free, and the vast majority of the rides (> 95 %) do end in this free period. So income from rides doesn't cover the expenses, and wasn't expected to.

13. Welcher Prozentsatz der Betriebskosten wird durch Verleiheinnahmen gedeckt? What percentage of operating costs is covered by rental income?
I can't give this information.

14. Haben Sie ein Computersystem, dass die Nachfrage schaetzt (wann und wo Raeder nachgefragt werden)? Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
As mentioned above, we have processes to do that. As of now there's no fully computerized model as this is in fact a very complex issue.

15. Gibt es bei Ihnen Programme oder Anreize die die Nachfrage steuern? Z.B. billigere Ausleihgebuehr fuer Fahrten entgegen des generellen Pendlerstroms zu Spitzenzeiten? Do you use any marketing or promotional strategies to try to alter cycling patterns? How do you prepare stations for large crowds?
Most of our rides are already free, so ride fees are not an option for creating such an incentive. As of now, we have no such program.

16. Gibt es bei Ihnen ein spezielles Program, um Ihr Unternehmen nachhaltiger zu machen? (z.B. durch Solarenergienutzung fuer den Betrieb der Stationen oder elektrische Fahrzeuge zum Transport der Raeder?) Do you have any strategies to reduce the impact of your operations on the environment?
As of now, no.

17. Gibt es andere Probleme oder Lehren die sie aus dem Betrieb des Bike Sharing Systems gezogen haben und die Sie genre mit uns teilen wollen? What are the most valuable lessons you have learned from operating a public bicycle system?
As we have to little to no problem with vandalism and theft, we do believe that the mandatory registration with full name and address is vital

to our success. This enables us to transfer responsibility for the bike to the user, who in turn takes more care. Furthermore, keeping both stations and bikes in good condition not just mechanically but also optically is important too. Graffiti, stickers etc. are removed as quick as possible (and since every station gets visited several times a week by our technicians, it's noticed rather quick), which in turn keeps this incidents low in the first place.

Barcelona Response #1 (ClearChannel):

1. How many bikes do you have available? How many bike docks do you have available?
We have 6.000 bikes and 11.181 bike docks distributed in 420 bike stations.

2. How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?
Total members is 130.200, all of them annual as municipality of Barcelona decided to do not have short-term subscribers

3. How are bikes taken out of and reintroduced into the system for maintenance?
Our regulation teams are using vans with a trailer attached (approximate capacity is 30 bikes) for removing bikes from stations.

4. What is the average number of checkouts per station?
We have an average of 45.000 checkouts per day, so easy to get the average per stations (420 stations) but I don't feel this ratio very important as there is a high dispersion. Key ratio is per bike (average times a bike is used every day). This is the key ratio to understand how busy is the service.

5. What is the average time and distance traveled per ride?
Average riding time is 20 min and approx 2,8 Km.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
This is the most difficult activity within a bike sharing service (at least this is my personal experience managing several bike sharing programs) and the one that consumes more effort and cost. It is performed by vans that moves bikes between stations. General speaking, this is done in two steps: night regulation to set up the optimal scenario at the starting point of the day and live regulation during the day. Regulation is plan using forecasting tools that helps our operation centre.

7. Do your revenues cover all of the costs of operating the public bicycle system?
In none of the bike sharing programs I know the revenues from users are enough to cover the operation cost.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
Yes, we have this kind of software (not predicting people usage but net demand at each station per hour). Basically it provides from which stations we need to remove bikes and into which stations we have to fill the bikes.

9. Do you use any marketing or promotional strategies to try to alter cycling patterns? How do you prepare stations for large crowds?
No, we don't use this because we don't believe that a user will change its transport needs thanks to a marketing promotion. It is impossible to manage large crowds like sports events, concerts, etc... I would recommend to close the stations in the area. Normally but happens is that the stations in the area of the event became full very quickly and you cannot regulate them. If you send the regulation vans to remove the bikes those vans will be stock in the traffic. Strategies like increasing capacity using removable stations are just for marketing. Reality is that in a real large crowd you need lot of extra bike docks and it is not affordable to do such an investment for few events during the year.

10. Do you have any strategies to reduce the impact of your operations on the environment?
We are introducing electrical vans but it has to be consider that today electrical vans are much more expensive than normal ones.

11. Do you have one general warehouse or a system of warehouses for storing bicycles?
In Barcelona we have 2 warehouses.

12. What are the most valuable lessons you have learned from operating a public bicycle system?
I've learned a lot of lessons before 4 years implementing and operating public bike systems in different European and American cities. Let's say that the most valuable lesson I've learned is that it is key to manage the expectations of the municipality representatives (politicians, transport entities, ...) and the subscribers. Another one is that you have to manage the balance between offer and demand, so you have to keep the right balance between the system capacity and the subscribers you accept.

Barcelona Response #2 (Bicing):

1. How many bikes do you have available? 6000 How many bike docks do you
have available?
420 stations, 11190 anchors

2. How many total members do you have? 120.000 How many have an annual
membership?
All of them, it is the only option. No short rentals or memberships. How many have a daily or short-term membership? Zero.

3. How are bikes taken out of and reintroduced into the system for maintenance?
Sorry, I don't understand the question. They are taken out of the street when the van sees them broken, or when the station blocks them for being broken (after three times different people returns it to the system) we go and get them. Once they are repaired, we put them back again in the street, in a station.

4. What is the average number of checkouts per station?
If you ask for the number of people that check out the bike has been returned correctly in the system by passing the card, it's about 15% only.

5. What is the average time and distance traveled per ride?
15 min; 2,5 km.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
Yes, it does, the city is in a slope. We have to rebalance with our vans. We have a system that tells us how the stations are at any moment, so we know where we have to empty stations, and where we have to load stations.

7. Do your revenues cover all of the costs of operating the public

bicycle system?
No. Only 25%.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
No prediction, data in real time of how many bikes and free anchors there is in each station. Humans do the predictions with the data and their experience. The moves of the users are almost the same every day.

9. Do you use any marketing or promotional strategies to try to alter cycling patterns?
No. How do you prepare stations for large crowds? We close them if there is a security argument behind. Take the bikes and close the anchors so none can park there.

10. Do you have any strategies to reduce the impact of your operations on the environment?
Looking forward for electrical vans. Not possible yet for the amount of kilometersthat they have to cover every day.

11. Do you have one general warehouse or a system of warehouses for storing bicycles?
2 warehouses.

12. What are the most valuable lessons you have learned from operating a public bicycle system?
Be careful with robberies and vandalism. Build a strong, unvulnerable station. The maintenance of the bikes is key too. And, of course, the informatic sistem that holds the whole ting has to be very strong and stable.

Denver Response:

1. How many bikes do you have available? How many bike docks do you have available?
510 bikes, 702 Docks

2. How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?
YTD – 2,600 Annual members and 40,000 walk up users

3. How are bikes taken out of the system for maintenance? How are repaired bikes reintroduced into the system?
Bikes are divvied up into four groups and tuned up every three weeks. We balancing using human power wherever possible, but primarily with truck/trailer combo.

4. What is the average number of checkouts per station?
YTD, we average about 3,600 checkouts per station.

5. What is the average time and distance traveled per ride?
Data isn't calculated until end of season.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
There are stations we know from experience will be full or empty depending on the time of day. We have 2 GMC trucks/trailer combo that allows us to distribute 24 bikes at a time per vehicle. Our software gives us displays and reports when stations are nearing capacity or emptying out. Daily commuters have a pattern of flowing into the city center during morning commutes and out during evening. Weekend (walk up

users) are unpredictable.

7. Do your revenues cover all of the costs of operating the bikeshare system?
Our system is self-sustaining as far as operations go. We are dependent on sponsorship, grant and private donations for our expansion capital.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
We use a proprietary system provided by B-cycle National. It uses a combination of visual mapping and alerts.

9. Do you use any marketing or promotional tactics to try to effect where and when rides take place?
No incentives for station destination or origination points. We have a pilot low income project to discover how we could promote low income usage at nearby stations.

10. Do you have any strategies to reduce the impact of your operations on the environment?
We install solar powered stations wherever possible. Our fleet of balancing vehicles was converted to Compressed natural gas via a grant from a local CNG producer. We combine trips with emission-creating vehicles wherever possible and are able to use a bike/bike trailer for balancing when 4 or less bikes need moved.

11. Do you have a general warehouse? Or a system of warehouses?
We have a central warehouse and operations center where bikes are worked on and can be stored in small quantities during operating months. During winter we have a remote warehouse to store bikes that are serviced and ready for the next season.

12. Do you have any other lessons-learned in bikesharing operations that you would be willing to share?
Bike sharing works best in conjunction with other policy changes (parking cost increases, infrastructure rollout, etc)

Mexico City Response:

1. ¿Cuántos puestos hay en cada estación? ¿Cuántas bicicletas están habilitadas? How many bike docks do you have available? How many bikes do you have available?
The average size of an ECOBICI station has 27 docks. The range varies from 12 to 36 docks per station. In total, the system has 1,200 bicycles in circulation and approximately 403 bikes in storage, if needed.

2. ¿Cuántos miembros en total están inscritos en su sistema de renta compartida de bicicletas (ECOBICI)? ¿Cuántos miembros hay en los diferentes tipos de membresía (anuales, mensuales, diarias)? How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?
Currently only annual memberships are available. We have 34,351 registered users that have joined since February 16, 2010 until October 24 of this year.

3. ¿Cómo manejan el servicio de mantenimiento de bicicletas y cuánto tiempo demoran en ser puestas nuevamente al servicio de los usuarios? How are bikes taken out of the system for maintenance? How are repaired bikes reintroduced into the system?
The bicycle maintenance is done daily. There are two types of maintenance. The first is a preventive maintenance that is performed during balancing of each station (air tires, adjust brakes, seat adjustment) and the second is a corrective maintenance performed at the ECOBICI workshop. The latter is made on the bikes that can not be repaired at the station. Depending on the type of maintenance, the time that each

bike stays at the shop varies. But, bikes do not stay at the shop more than 24 hours.

4. ¿Cuál es el promedio del número de retiros de bicicletas por estación (diario, mensual o anual)? What is the average number of checkouts per station?
On average, 77 daily checkouts and 2,298 monthly checkouts are made per station.

5. ¿Cual es el tiempo promedio que las bicicletas son utilizadas y la distancia que recorren? ¿Nos podría decir cuáles son? What is the average time and distance traveled per ride?
According to the information recorded by the ECOBICI Information System, the average time per trip is 20 min. Considering an average speed of 16.5 km/h, the average distance traveled is approximately 4.5 kilometers (2.8 miles approx.)

6. Estamos interesados en saber cómo mantiene el balance entre el número de bicicletas en las estaciones y el número de espacios vacíos para dejar las bicicletas.... Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
Once we received information on users' trips, we analyzed it to calculate the net demand of each station per time and day; i.e., how many bikes are available (number of check in - checkouts). Using this information we conducted an analysis of check-outs and check-ins during peak hours and developed distribution routes for those stations that at certain times were always empty or full. Also, we use mapping to establish efficient routes so that shorter trips can be made to balance those stations (ie distribution of bikes) and take bikes from full stations to empty ones to meet the demand for the next peak hour.
The system currently has 11 ECOBICI low emission balancing electric vehicles; each includes a trailer that accommodates 27 bicycles. Likewise, the system has one truck that accommodates up to 40 bicycles. The vehicles are distributed in 4 shifts of operation.
In addition, the current area of operation is divided into 4 main areas with different routes per area. Routes vary depending on the following criteria: distribution of stations with more demand, city traffic, and the connection in primary and secondary streets.

7. Estamos interesados en saber qué porcentaje del costo por operar el sistema está cubierto por los ingresos que éste les genera. ¿Tienen alguna meta de ingresos o ganancias que deben cumplir anual/mensual? Do your revenues cover all of the costs of operating the bikeshare system?
Currently there is no revenue goal; the aim is to expand the system in a way that we can implement a new financial model that can seek more revenue for the system.

8. ¿Utilizan algún tipo de software para poder predecir dónde y cuándo las personas usarán las bicicletas? Si así fuere, ¿qué tipo de información es accesible a las personas que trabajan operando el sistema? Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
Yes, we use specialized software to operate the system. All stations are connected via a GPRS that sends real-time information to a control system, which allows for registering and updating the status of each station and bicycle. It also registers information on how many docks and bikes are available per station; it doesn't matter if docks or bikes are broken or if the station is not active.
Currently we do not have software that allows us to forecast where and when bikes will be used, but rather we rely on historical information. Data collected during the 20 months of operation makes it possible to

predict users' behavior based on the main points of origin and destination of trips, stations with increased demand, and the combination of use with other modes of transport.

9. ¿Utilizan algún tipo de estrategias de marketing para orientar y promover el uso de las bicicletas a ciertos destinos en especial más que a otros y en ciertas horas específicas? Do you use any marketing or promotional tactics to try to effect where and when rides take place?
At the moment we do not have any kind of incentive for ECOBICI users that check-in or check-out bikes to specific destinations or stations; however, we are evaluating schemes that can support balancing stations with higher demand, by implementing a reward system as they do in other systems worldwide, including: Vélib, Bike Bicing or Capital Share.

10. Nos interesaría conocer si ustedes incluyen estrategias de protección medio ambiental en las operaciones en el sistema. Do you have any strategies to reduce the impact of your operations on the environment?
Currently, ECOBICI has 11 balancing electric low emission vehicles. It is important to mention that we are evaluating the effective performance of these vehicles in the reduction of carbon emissions because our records show a considerable amount of electricity consumption.

11. ¿Cuentan con sólo un centro de operaciones/almacén general? ¿O son múltiples locaciones? Do you have a general warehouse? Or a system of warehouses?
The current phase of ECOBICI (90 stations and 1,200 bicycles in operation) only requires one general warehouse for operations and maintenance. The warehouse is in a strategic location within the area of operation to allow easy access and adequate planning for operation and maintenance routes.

12. Podría compartir con nosotros alguna otra recomendación o lección que haya aprendido acerca de cómo trabaja su sistema de operaciones. Do you have any other lessons-learned in bikesharing operations that you would be willing to share?
Beyond a specific recommendation and based on the experience gained, we consider that monitoring the operation of ECOBICI's system means establishing indicators and adequate measurement systems suitable for the level of service that we intend to provide. The further combination of the monitoring results with an effective analyzes allow us to develop strategies that can address current and future needs of our users and the system.

Kaohsiung City Response:

1. How many bikes do you have available? How many bike docks do you have available?
There are 49 self- service bike docks and 500 bicycles in operation now. In 2012, we will have 74 rental stations and 1000 bicycles provided for service.

2. How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?
We do not recruit new members for renting public bikes. Nowadays there are two ways using C-bike system. One is credit card and the other is I Pass card. I Pass card, the most popular traffic ticketing in southern Taiwan, is also used for Kaohsiung MRT system, buses and ferries.

3. How are bikes taken out of and reintroduced into the system for maintenance?
We adopt rack-frame type as the design of rental stations, which means all bicycles share one parking rack. Repairmen can get a maintenance card to take all bicycles out of racks and reintroduce into the system in few minutes.

4. What is the average number of checkouts per station?

The average number of checkouts per station is about 317 persons on October.

5. What is the average time and distance traveled per ride?
The average traveling time per ride is about 40 minutes. The average traveling distance per ride will be 10 kilometers if the speed is 15 km/hr.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
Repairmen are in charge of maintaining the central monitoring system and check to see if all stations work well. They will undergo daily safety inspection to all bikes, use the truck to distribute bicycles and stack them in a van if necessary. 3.5 tons Maintenance Truck (see email for photo)

7. Do your revenues cover all of the costs of operating the public bicycle system?
Environmental Protection Bureau of Kaohsiung City Government (KSEPB) authorized Kaohsiung Rapid Transit Corporation (KRTC) to operate public bikes one year from August 2011. All rental equipments and bicycles belong to KSEPB, and KRTC is in charge of the operation.
The main purpose of setting public bike system is to transform Kaohsiung City into a low-carbon city and encourage citizens to take up cycling instead of using motorcycles as commuting, studying and traveling. Although the revenue can not cover all of the costs of operation, we have the faith to build a non-profit cycling environment.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
We use the central monitoring system to get in-time operation information of all situations. Through the system, repairmen can redistribute all bikes immediately once the mount is up to the maximum or down to the minimum. In addition, the system will help us to know if all stations work well; if not, we will send maintenance stuffs to undergo necessary inspection.

9. Do you use any marketing or promotional strategies to try to alter cycling patterns? How do you prepare stations for large crowds?
1. We will continuously use lower pricing as incentives to encourage people to experience the most cycling environment in Taiwan. Besides, integrating with I Pass card is another important promotional strategy to alter cycling patterns. I Pass card, issued more than 2.1 million, is non-contact smart card and used for Kaohsiung MRT system, buses and ferries. In the end of 2011, I Pass card will be also available in public bike system.
2. Before weekend or holiday is coming, repairmen will redistribute the amount of bikes in some hot stations in advance. During these big days, repairmen will notice the renting situation by central monitoring system and flexibly adjust the amount of bikes to keep all stations operate well.

10. Do you have any strategies to reduce the impact of your operations on the environment?
On the weekend or during holidays, it is inevitable for repairmen to drive maintenance truck frequently and undergo bicycle distribution tasks, which may cause more air pollution. For this reason, we come up with two strategies to reduce the impact on the environment. One is daily planning the shortest inspection route and cutting some unnecessary routes to maintain the operation quality. The other strategy is undergoing properly bicycle distribution tasks at the end of the day. In this way, we will keep a stable operation without facing the full or empty

problems all the time.

11. Do you have one general warehouse or a system of warehouses for storing bicycles?
There is a general warehouse for storing bicycles and parking two maintenance trucks.

12. What are the most valuable lessons you have learned from operating a public bicycle system?
Kaohsiung City Government not only set up public bike rental system, but also continuously increased financial investment to build and integrate bicycle routes. There are 9 major bicycle routes which is 500 km length. Due to the friendly cycling construction, Kaohsiung was ranked 3rd in CNN's 5 best biking cities of 2010. In addition of city properties, the trend of environmental protection, smooth cycling roads, mature techniques and the citizen acceptability, the environment of developing public bicycle is much maturer than other cities.

Minneapolis, MN (Nice Ride) Response:

1. How many bikes do you have available? How many bike docks do you have available?
We own 1200 bikes although we don't have that many on the street. At any point in time there are generally about 50-75 that have been pulled for maintenance, also, we have a few too many bikes for the number of docks in the system right now. Our current system has the capacity for around 1000 bikes. We currently have just under 2000 dock in the system. All this data is available for our system as well as many others world wide on Oliver O'Brien's bike sharing maps: http://bikes.oobrien.com/?city=minneapolis

2. How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?
We currently have around 3700 1 year subscribers. I haven't compiled exact numbers for casual (24hr) subscriptions sold this year but I would estimate that we sold approximately 30,000. We also sold around 100 30-day subscriptions

3. How are bikes taken out of the system for maintenance? How are repaired bikes reintroduced into the system?
Our system is exactly the same as that used by Capital Bikeshare - manufactured by Public Bike System Company of Montreal. Each dock has a button on it which can be used to notify us of bikes needing repair. When a bike is marked for repair one of our street crew goes out and pick it up. We have a contract with a local bike shop to do about 90% of the repair work on the bikes. All but the simplest of repairs is handled by them. As soon as they're finished, the bikes are picked up by one of our trucks and they go back on the street.

4. What is the average number of checkouts per station?
This varies widely based on the location. I have a station in the downtown core that has had 9700 rentals this year, meanwhile there's another in a low income neighborhood that has had 97 for the same period.

5. What is the average time and distance traveled per ride?
I don't have a number for this - we may calculate it after our season ends but it's a very complicated number given that there have been over 200K rentals this year. In general bikeshare trips are short, typically under three miles.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?
We have two trucks with trailers that work from 6:30am to 1am every

day. The trucks are compact pickups with custom built trailers. Each truck typically has two people in it. We typically move between 150 and 350 bikes per day. We monitor station capacity using real time maps, mostly the O'Brien map mentioned above.

7. Do your revenues cover all of the costs of operating the bikeshare system?

No. We're a non-profit. We run a very lean company. We usually have about 6 full time employees and 6-8 seasonal employees. Our goal is to cover operating costs through a combination of system revenue and private sponsorship. In addition to this we need to build cash reserves for future equipment replacement. So far we've been able to cover operating costs, although we have not been able to build reserves. The majority of system revenue comes from 24hr subscribers. I would estimate the ration of system revenue to sponsorship dollars will work out to about 50/50.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?

We do not use any predictive modeling. I've heard that this is being developed by Alta Bikeshare (who run DC, Boston and New York) but I don't have any details. My staff tend to be fairly low skilled when it comes to technology so we primarily use online maps that are publicly available. We like to say that we have the best rebalancing of any system but there's more to it than that. The truth is our usage is so low compared to systems like DC that we just don;t have much of a rebalancing challenge. We move about 10% of the number of bikes in a day that a city like Montreal moves. We've had a total of around 310K rentals during the same number of operating months DC has had something like 1.3M. We've got 3700 subscribers, DC has 18K. Our systems are nearly identical in size so as you can see we have a lot of excess capacity which makes rebalancing very easy by comparison.

9. Do you use any marketing or promotional tactics to try to effect where and when rides take place?

We have tried to increase subscriptions in low income communities but this has nothing to do with trying to effect where rides take place or the movement of bikes. We have not used any incentives to aid in rebalancing.

10. Do you have any strategies to reduce the impact of your operations on the environment?

We spent a whole bunch of money on two electric trucks that we had intended to use for rebalancing. Unfortunately they had to be replaced by standard pickups because they wouldn't hold a battery charge long enough to be an effective rebalancing vehicle. We do a small amount of maintenance work using cargo bikes. I'd like to see this increase in the future.

11. Do you have a general warehouse? Or a system of warehouses?

We currently have about 1000 sq feet in a warehouse that we share with a lawn service. We also have some outdoor yard space to store trucks, trailers and other equipment. We're looking to find a combined warehouse/office space so we can consolidate our operations in one location. We're planning to store our equipment in an unused builing at the State Fair gorunds over the winter.

12. Do you have any other lessons-learned in bikesharing operations that you would be willing to share?

I've tried to be as transparent about our operations as possible. I think this is critical to spreading bike sharing to other cities. Since we were one of the first system in the US we've been used as a model for other cities who are considering bikeshare. I'm more than happy to share any part of our operations with you. I'll be releasing lots of system data over the next couple of months along with results of a subscriber survey - watch our website for details or subscribe to our feed: https://www.niceridemn.org/news/

JCDecaux Response

1. How many bikes do you have available? How many bike docks do you have available?

Worldwide, JCDecaux operates 46,600 bikes in close to 60 different cities, with 3,800 bike racks.We've operated self-service bicycle systems for 8 years and the total number of bike rides amounts to 200 million journeys cycled by users all over the world.In Paris, which is the largest system operated in the world, there are 20,600 bikes, 1,451 bike stations, to which we added, in 2009, 3,800 bikes and 300 stations to cover the 30 surrounding suburbs of the city.

2. How many total members do you have? How many have an annual membership? How many have a daily or short-term membership?

Paris and Lyon are the best illustrations of this :
In Paris, there are 210,000 annual subscribers to the Velib' system and since its beginnings in july 2007, there have been over 10 million short-term one-day or seven-day passes used.
In Lyon, the second largest system with 350 stations overall, there are close to 42,000 annual subscribers

3. How are bikes taken out of the system for maintenance? How are repaired bikes reintroduced into the system?

Again, the most significant example of a large-scale operation is Paris. Maintenance is carried out on an ongoing basis by manned teams who clean and maintain the stations, the racks and the bikes themselves and they also put back into the system the bikes that have been repaired. When a bike needs more significant maintenance or repairs, it is taken out of the station and brought to one of the dedicated workshops. It is then put back into circulation at a station by the maintenance teams.

4. What is the average number of checkouts per station?

stations differ widely from one part of the city to another : their size varies from approx. 15 to 25 or more cycle racks, they can be placed in very dense parts of the city or more residential areas, so it isn't an indicator that we follow particularly. We track the total number of journeys per day on the totality of each system and it's an operational indicator of the systems' efficiency and attractiveness. For example, in Paris, there are approx. between 80,000 and 120,000 trips cycled per day.

5. What is the average time and distance traveled per ride?

Again, this varies widely from one city to another, based on the size of the city in particular but also linked to the fact that in all systems operated by JCDecaux, the first 30 minutes of each journey are free of charge. This entails that the vast majority of users ride just under 30 minutes before putting back their bikes. On a worldwide basis, average duration of a ride is approx. 20 minutes, well under the 30-minute limit.

6. Does your system require a lot of effort to keep stations from becoming full or empty, and if so, how do you plan and perform station rebalancing?

The systems are built to self-regulate, meaning that in 90% of cases it's'the users themselves, by using the system, who naturally regulate bikes in the stations. Also, they are helped by the system - if a user for example wants to put his/her bike in a station and finds that it is full, the station has a map showing available slots in the surrounding stations. There is also a mobile app calles AllBikesNow that delivers real time information on all stations with the number or available bikes and slots. For the remaining bikes, manned regulation is carried out with vehicules. This is done using software applications to indicate where and

when bikes need to be regulated.

7. Do your revenues cover all of the costs of operating the bikeshare system?
JCDecaux has operated since its origins on an original business model, providing services to cities in exchange for the right to sell advertising space on street furniture. In this sense the bikesharing systems are all based on this model, varying from one city to another according to advertising potential. In somme cities like Paris, revenues generated by Velib go to the city, costs are supported by JCDecaux and our revenues come from advertising. This sytem is balanced specifically and fine-tuned in each city we operate, the contract ranging from approx. 10 to 15 years.

8. Do you use any IT or software systems to predict where and when people will use the bicycles, and what information does the software provide to employees?
Answers above in Q6 + the system takes into account some sort of pre-dictive system mainly based on our years of experience with the system (for example, bikes are taken out in the morning in residential areas and cycled to the business parts of town etc).

9. Do you use any marketing or promotional tactics to try to effect where and when rides take place?
We use such a system in Paris where close to 100 stations are posi-tionned on elevated parts of the city. If a user takes a bike out in a flat part of town and rides it back up to the top of a hill, he/she is rewarded with a 15 minute riding credit to be used on the spot or for a future ride.

10. Do you have any strategies to reduce the impact of your operations on the environment?
There are several elements in this: The bike itself is 99% recyclable so for example when a bike cannot be repaired it is dismantled and each part recycled. We have green electricity contracts to run the system. One of the bike workshops is a barge that navigates the river and this avoids using too many trucks.

11. Do you have a general warehouse? Or a system of warehouses?
It depends - small systems will have a single warehouse and larger cities will require several.

12. Do you have any other lessons-learned in bikesharing operations that you would be willing to share?
Please refer to the presentation attached.

VII. Appendix 3b. Mexico City response

Secretaría del Medio Ambiente
Dirección General de Bosques Urbanos y Educación Ambiental
Dirección de Reforestación Urbana, Parques y Ciclovías
Coordinación de la Estrategia de Movilidad en Bicicleta

México D.F., a 1 de noviembre del 2011.

COLABORACIÓN ECOBICI - UNIVERSIDAD VIRGINIA TECH
WASHINGTON D.C. ESTADOS UNIDOS

El día 25 de octubre, se hizo llegar al equipo técnico de la Estrategia de Movilidad en Bicicleta (EMB) por medio de la C. Paola Reyes, una serie de preguntas respecto al Sistema de Transporte Individual ECOBICI. Estas preguntas buscan obtener información para una investigación sobre bicicletas públicas en distintas partes del mundo, que realiza en universidad Virginia Tech en colaboración con Capital Bikeshare (el sistema de bicicletas públicas de Washington D.C. en Estados Unidos).

A continuación se presenta la información solicitada y desarrollada por el equipo de la EMB.

1. **¿Cuántos puestos hay en cada estación? ¿Cuántas bicicletas están habilitadas?**

El tamaño promedio de las cicloestaciones del Sistema ECOBICI es de 27 anclajes y el rango varía desde 12 hasta 36 anclajes por cicloestación. En total se cuenta con 1,200 bicicletas en circulación y se tienen aproximadamente 403 bicicletas en almacén, en caso de que sea necesario utilizarlas.

2. **¿Cuántos miembros en total están inscritos en su sistema de renta compartida de bicicletas (ECOBICI)? ¿Cuántos miembros hay en los diferentes tipos de membresía (anuales, mensuales, diarias)?**

Actualmente sólo se maneja una membresía anual y contamos con 34,351 usuarios registrados desde el 16 de febrero de 2010 hasta el 24 de octubre de este año.

3. **¿Cómo manejan el servicio de mantenimiento de bicicletas y cuánto tiempo demoran en ser puestas nuevamente al servicio de los usuarios?**

El mantenimiento a las bicicletas se realiza diariamente; existen dos tipos de mantenimiento, el primero es un trabajo preventivo durante el balanceo de la cicloestación (aire de llantas, ajuste de frenos, ajuste de sillín) y el segundo es un mantenimiento correctivo en el taller de ECOBICI, este último se realiza a las bicicletas que no pueden ser reparadas en la cicloestación. Dependiendo del tipo de mantenimiento, varía el tiempo que cada bicicleta permanece en el taller; sin embargo, ninguna bicicleta permanece en el taller más de 24 horas.

4. **¿Saben el promedio del número de retiros de bicicletas por estación (diario, mensual o anual)? ¿Nos podría decir cuál es?**

En promedio se realizan 77 retiros diarios en cada cicloestación y 2,298 retiros promedio mensuales por cicloestación.

5. **¿Saben el tiempo promedio que las bicicletas son utilizadas y la distancia que recorren? ¿Nos podría decir cuáles son?**

De acuerdo con la información registrada por el Sistema Informático de ECOBICI, el tiempo promedio por viaje es de 20 min. Si tomamos en cuenta una velocidad promedio de 16.5 km/h. la distancia recorrida es aproximadamente de 4.5 kilómetros.

Circuito de los Compositores s/n
2ª Sección del Bosque de Chapultepec
Tel. 5273-2949

Secretaría del
Medio Ambiente

Secretaría del Medio Ambiente
Dirección General de Bosques Urbanos y Educación Ambiental
Dirección de Reforestación Urbana, Parques y Ciclovías
Coordinación de la Estrategia de Movilidad en Bicicleta

6. **Estamos interesados en saber cómo mantiene el balance entre el número de bicicletas en las estaciones y el número de espacios vacíos para dejar las bicicletas. ¿Cómo es que distribuyen las bicicletas entre las estaciones y cómo calculan el número de bicicletas que van a ser movilizadas? De igual manera, queremos saber cómo escogen las estaciones a las cuales van a ser distribuidas. En general, ¿requiere de mucho trabajo controlar este balance? Si así fuere, ¿qué estrategias o mejoras planean implementar para mejorar esta dificultad? ¿Nos podría decir algún otro detalle de cómo manejan este sistema de balance?**

Una vez que se tuvo información sobre los viajes de los usuarios en el sistema, se realizó un análisis para calcular la Demanda Neta de las cicloestaciones por día y hora, es decir, cuántas bicicletas están disponibles (Bicicletas que llegan - Bicicletas que se retiran). Con esta información se realizó un análisis de las horas pico de retiradas y de llegadas, planteando rutas de distribución para aquellas cicloestaciones que en ciertos horarios quedaban siempre vacías o llenas; que, junto con recorridos y mapeos establecieron las rutas, de tal forma que los viajes fueran de menor distancia y en los que se pudieran balancear las cicloestaciones, esto es, distribuir las bicicletas de las cicloestaciones llenas y llevarlas a las cicloestaciones vacías para cubrir la demanda de servicio en la siguiente hora pico.

Actualmente el Sistema ECOBICI cuenta con 11 vehículos eléctricos de balanceo de bajo nivel de emisiones contaminantes con un remolque cada uno, mismos que permiten albergar hasta 27 bicicletas cada uno. De igual forma se cuenta con un camión que permite albergar hasta 40 bicicletas. Dichos vehículos se encuentran distribuidos en 4 turnos de operación.

Adicionalmente, el polígono actual de operación se encuentra dividido en cuatro zonas principales en donde se realizan diversas rutas por zona, de acuerdo con la distribución de las cicloestaciones con mayor demanda, el tránsito de la ciudad, la conexión en avenidas secundarias y primarias como los principales criterios.

7. **Estamos interesados en saber qué porcentaje del costo por operar el sistema está cubierto por los ingresos que éste les genera. ¿Tienen alguna meta de ingresos o ganancias que deben cumplir anual/mensual?**

Actualmente no se cuenta con ninguna meta de ingresos, se pretende que con la expansión del sistema se pueda implementar un nuevo modelo de financiero que busque mayores ingresos para el sistema.

8. **Nos interesa saber si es que ustedes utilizan algún software, plan de distribución, mapas virtuales interactivos, o algún otro programa de computadora que les ayude a saber cuando las estaciones están llenas o vacías. ¿Utilizan algún tipo de software para poder predecir dónde y cuándo las personas usarán las bicicletas? Si así fuere, ¿qué tipo de información es accesible a las personas que trabajan operando el sistema?**

Sí, existe un software especializado para la operación del sistema, las cicloestaciones están conectadas mediante GPRS y se manda la información en tiempo real a un sistema de control que permite mantener actualizado y registrado el estatus de cada cicloestación y bicicleta. Así como cuantos anclajes y bicicletas hay disponibles, si hay anclajes o bicicletas descompuestas y si las cicloestaciones están activas o no.

Actualmente no contamos con un software que nos permita predecir dónde y cuándo se usarán las bicicletas, pero nos basamos en la información histórica del sistema durante estos 20 meses de operación de tal forma que sea posible prever el comportamiento de los usuarios de acuerdo con los principales puntos de origen y destino, las cicloestaciones de mayor demanda y la intermodalidad con otros medios de transporte.

9. **¿Utilizan algún tipo de estrategias de marketing para orientar y promover el uso de las bicicletas a ciertos destinos en especial más que a otros y en ciertas horas específicas? Por ejemplo, ¿ofrecen algún tipo de incentivos para los usuarios que utilizan las bicicletas fuera de las horas de mayor uso (horas punta o pico), o incentivos para aquellos que utilizan las estaciones que están menos**

Circuito de los Compositores s/n
2ª Sección del Bosque de Chapultepec
Tel. 5273-2949

40

Secretaría del Medio Ambiente
Dirección General de Bosques Urbanos y Educación Ambiental
Dirección de Reforestación Urbana, Parques y Ciclovías
Coordinación de la Estrategia de Movilidad en Bicicleta

ocupadas? ¿Quizás ofrecen diferentes tipos de membresías (menor precio) en las estaciones que son menos populares?

Por el momento no manejamos ningún tipo de incentivo para los usuarios de ECOBICI que se enfoque en orientar los retiros o devoluciones de bicicletas a destinos específicos, sin embargo nos encontramos evaluando esquemas que permitan apoyar una gran parte del balanceo de bicicletas o anclajes en las cicloestaciones con mayor demanda, mediante la implementación de un sistema de recompensas como lo hacen en otros sistemas a nivel mundial por ejemplo: Vélib, Bicing o Capital Bike Share.

10. **Nos interesaría conocer si ustedes incluyen estrategias de protección medio ambiental en las operaciones en el sistema. Por ejemplo, si ubican las estaciones en superficies permeables, o si utilizan los vehículos de balance y transporte con bajo nivel de emisión contaminante. ¿Utilizan algún elemento de energía solar pasiva o alguna otra estrategia que les ayude a reducir el impacto ambiental de las operaciones diarias?**

Actualmente ECOBICI cuenta con 11 vehículos eléctricos de balanceo de bajo nivel de emisiones contaminantes. Es importante señalar que se está evaluando el desempeño obtenido por estos vehículos en la reducción efectiva de emisiones de carbono, ya que el consumo de energía eléctrica registrado ha sido considerable.

11. **¿Cuentan con sólo un centro de operaciones/almacén general? ¿O son múltiples locaciones?**
La fase actual del Sistema ECOBICI (90 cicloestaciones y 1,200 bicicletas en operación) sólo requiere un centro de operaciones y mantenimiento mismo que se encuentra ubicado en una zona estratégica del polígono que permite el fácil acceso y la planeación y adecuación de las rutas de mantenimiento y operación.

12. **Podría compartir con nosotros alguna otra recomendación o lección que haya aprendido acerca de cómo trabaja su sistema de operaciones.**

Más allá de una recomendación específica sobre el sistema de operaciones, consideramos que el seguimiento a la operación del Sistema ECOBICI de acuerdo a la experiencia obtenida, consiste en establecer indicadores, niveles y sistemas de medición adecuados con respecto al nivel de servicio que se pretende brindar al usuario y lograr combinar estos resultados con métodos de análisis efectivos que permitan establecer estrategias de acuerdo con las necesidades actuales y futuras de los usuarios y el sistema.

A T E N T A M E N T E

EL COORDINADOR
ARQ. RODRIGO GUERRERO MALDONADO

Circuito de los Compositores s/n
2ª Sección del Bosque de Chapultepec
Tel. 5273-2949

41

Bicycle & Infrastructure

- Add Bicycle Locks
- Add Maps & Station Locations on Bike
- Cupholders
- Helmets w/ Disposable Shower Caps
- Trashbin at Kiosk
- Larger, Better and More Baskets
- 9-Speed Bicycles

Operations & Marketing

- Better Method to Flag Bicycle for Repairs (Flag, Red Light on Station)
- Temporary Access for New Annual Members (until key fob arrives)
- Print Unlock Code before or on Receipt
- Increase "Free Time" from 30 to 45 minutes
- Increase System Reliability
- CaBi Info & Brochures @ Hostels
- CaBi Maps at Hotels

Way Finding

- Flag or Locational Sign on Solar Array Pole for Increased Visibility
- Better Way to Identify CaBi Station from Afar
- Directional Signs at Key Intersections
- Signage at Metro Stations to nearested CaBi

> ## Virginia Tech Capital Bikeshare Intercept Survey

> You can include any text or info that will help people fill this out.

Survey

The following survey is a collaborative project between Capital Bikeshare and the Virginia Tech research group. Your answers, if you consent to the survey, will be used anonymously and will be used to improve the Bikeshare system. The survey will take just a few moments of your time - thank you for your participation.

Page 2   After page 1   Continue to next page

Consent

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Capital Bikeshare ("CaBi") Survey - UAP 5794 Environmental Studio

Investigator(s): Ralph Buehler, Darren Buck, Nicholas Kushner, Payton Chung, Partricia Happ, Timothy Maher, Natalie Borecki, Bradely Rawls, Graciela Reyes, Matthew Steenhoek, Casey Studhalter, & Austin Watkins.

I. Purpose of this Research/Project
The purpose of this research project is to gain information about CaBi's 1-day and 5-day system ("short-term") users to improve the bikeshare system. Researchers will identity daily system users on site, at CaBi bikeshare locations throughout the D.C. metro-region in fall 2011.

II. Procedures
The research procedures will involve conducting intercept surveys with 'short-term' system users. A series of questions, such as demographic information, modes of transportation, bikeshare experience, familiarity with stations/maps/infrastructure, and trip purpose, will be asked of the subject. Information gathered will be used to evaluate how the CaBi bikeshare system functions for daily users.

III. Risks
The researchers do not anticipate any risks or discomforts to survey participants ("subjects") due to either the type of questions asked nor how research data will be used. Survey results will be used in a way to preserve subjects anonymity so that identification will not be possible. Both the surveys collected and consent forms will be kept in separate safe, secure and locked locations.

IV. Benefits
The researchers have made no nor will they make any promise or guarantee to any benefits that may encourage you to participate. No tangible benefits to subjects have been identified. The contributions of subjects via survey responses will help the research team better evaluate how it presently serves daily users.

V. Extent of Anonymity and Confidentiality
The anonymity of subjects will be maintained since data used will not be linked to any information that could personally identify the subject.

It is possible that Virginia Tech's Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation
No compensation of any kind is provided or inferred to survey subjects by researchers.

VII. Freedom to Withdraw
Subjects are free to withdraw from a study at any time without penalty.

VIII. Subject's Responsibilities
By participating in the survey, subject voluntarily agree to participate in this study.

IX. Subject's Permission
Subject (I) understands the consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

Should I have any pertinent questions about this research or its conduct, and research subject's rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Investigator(s)   Telephone/e-mail

Ralph Buehler_____   703.706.8111/ ralphbu@vt.edu

Faculty Advisor   Telephone/e-mail

Thomas W Sanchez_____   540.231.5425/tom.sanchez@vt.edu
Departmental Reviewer/Department Head   Telephone/e-mail

David M. Moore   540-231-4991/moored@vt.edu
Chair, Virginia Tech Institutional Review   Telephone/e-mail
Board for the Protection of Human Subjects
Office of Research Compliance
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, VA 24060

Acknowledge of voluntary consent:

○ 1 (consent agreement)

○ 2 (does not consent - exit survey)

Survey Questions

Gender

○ 1 (Male)

○ 2 (Female)

○ Other: [_____]

Helmet Use:
Do you wear a helmet when riding the Capital Bikeshare bicycle?

○ 1 (Yes)

○ 2 (No)

Riding Alone or w/ Group:
Are you riding alone or with a group? If with a group, please enter the number in your party.

○ 1 (Alone)

⊙ Other: [_____]

1) Please enter your survey number?

[_____]

2) At what station did you receive this survey? *

[1. Massachusetts Ave & Dupont Circle NW ▼]

3) What type of bikeshare pass did you/will you purchase for this trip?

○ 1 (24-hour)

○ 2 (5-day)

4) What is your age?

[_____]

5) Which of the following best describes your racial or ethnic background?

○ 1 (Asian/Pacific Islander)

○ 2 (Black/African-American)

○ 3 (Caucasian)

○ 4 (Hispanic)

○ 5 (Native American/Alaska Native)

○ 6 (Other/Multi-Racial)

○ 7 (Prefer not to answer)

6) What is the highest level of education you have completed?

○ 1 (Less than high school)

○ 2 (High school/GED)

○ 3 (Some college)

○ 4 (2-year college degree)

○ 5 (4-year college degree)

○ 6 (Advanced degree (Masters, Doctoral))

○ 7 (Prefer not to answer)

7) What is the zip code where you primarily reside?

[_____]

7a) (If residing outside DC) How did you arrive in DC? (Check all that apply)

☐ 1 (Personal vehicle)

☐ 2 (Metro)

☐ 3 (Bus)

☐ 4 (Train (ie Amtrak, MARC))

☐ 5 (Taxi)

☐ 6 (Airplane)

☐ 7 (Not Applicable)

☐ Other: [_____]

7b) What is the primary purpose of your trip to DC?

○ 1 (Social/Personal Activities)

○ 2 (Recreation/Fitness)

○ 3 (Tourism / Site Seeing)

○ 4 (Work/Meeting)

○ 5 (Not Applicable)

○ Other: [_____]

8) Which of these statements best describes your bicycling experience? (Check only 1)

○ 1 (I ride frequently on city streets)

○ 2 (I ride frequently, mostly on trails or rural roads)

○ 3 (I ride several times a year)

○ 4 (I rarely ride a bicycle)

9) Thinking about your trip to DC, why are you using Capital Bikeshare today?

○ 1 (Social/Personal Activities)

○ 2 (Recreation/Fitness)

○ 3 (Tourism / Site Seeing)

○ 4 (Work/Meeting)

○ Other: [_____]

10) Is this your first ever use of a Capital Bikeshare bicycle?

○ 1 (Yes)

○ 2 (No)

10a) (If No) How many times prior have you purchased a 24 hour or 5 day Capital Bikeshare Membership?

[_____]

11) If you did not use Capital Bikeshare for this segment of your trip, how would you have completed the trip?

46

(check best that applies)

- ○ 1 (Would not have made trip)
- ○ 2 (Walking)
- ○ 3 (Personal Bicycle)
- ○ 4 (Public Transportation (metro, bus))
- ○ 5 (Personal automobile)
- ○ 6 (Taxi Cab)
- ○ Other: [_____]

12) Have you heard of the Capital Bikeshare smart phone app called Spot Cycle?

- ○ 1 (Yes)
- ○ 2 (No)

12a) (If yes) Have you used it?

- ○ 1 (Yes)
- ○ 2 (No)
- ○ 3 (Not Applicable)

13) What other modes of transportation are you using in connection with this Capital Bikeshare trip? (Check all that apply)

- ☐ 1 (Walk)
- ☐ 2 (Personal Bike)
- ☐ 3 (Public Transportation (Metro, Bus))
- ☐ 4 (Personal Automobile)
- ☐ 5 (Taxi Cab)
- ☐ 6 (None)
- ☐ Other: [_____]

14) How did you learn about Capital Bikeshare? (check best that applies)

- ○ 1 (Employer)
- ○ 2 (Verbal recommendation)
- ○ 3 (Social Media (ie. Facebook, Twitter))
- ○ 4 (Print Advertisement)
- ○ 5 (Internet)
- ○ 6 (Saw CaBi station or user)
- ○ Other: [_____]

15) Why did you purchase a 24-hour or 5-day pass instead of an annual Capital Bikeshare subscription? (read options) (Check all that apply)

47

☐ 1 (Don't live here)

☐ 2 (Not frequent enough user)

☐ 3 (Inconvenient Stations)

☐ 4 (Cost)

☐ 5 (Safety concerns)

☐ 6 (System reliability)

☐ 7 (Don't know/None)

☐ Other: [_____]

16) What about Capital Bikeshare would you most like to see improved? (check all that apply)

☐ 1 (More station locations & more bikes)

☐ 2 (Balancing - stations too frequently full or empty)

☐ 3 (Kiosk instructions confusing)

☐ 4 (Maps difficult to read)

☐ 5 (Pricing)

☐ 6 (Don't Know)

☐ Other: [_____]

17) If Capital Bikeshare were to add additional stations, where would you most like to see them? (Check all that apply)

☐ 1 (Downtown DC)

☐ 2 (National Mall)

☐ 3 (Arlington)

☐ 4 (Alexandria)

☐ 5 (Fairfax County)

☐ 6 (Montgomery County)

☐ 7 (Prince George County)

☐ 8 (Near my home)

☐ Other: [_____]

"For the final series of questions, you'll be asked to rate your opinion on a scale of 1-5"

18) Please rate your level of ease in understand is Capital Bikeshare's pricing structure:

○ 1 (difficult)

○ 2 (somewhat difficult)

○ 3 (neutral)

○ 4 (somewhat easy)

○ 5 (easy)

○ 6 (unsure/I don't know)

19) Please rate your level of satisfaction with the overall state/condition of bike lanes in the metro DC area:

○ 1 (unsatisfied)

○ 2 (somewhat unsatisfied)

○ 3 (neutral)

○ 4 (somewhat satisfied)

○ 5 (satisfied)

○ 6 (unsure/I don't know)

20) Please rate your level of ease in using the Capital Bikeshare station kiosk(s):

○ 1 (difficult)

○ 2 (somewhat difficult)

○ 3 (neutral)

○ 4 (somewhat easy)

○ 5 (easy)

○ 6 (unsure/I don't know)

Page 4   After page 3 | Continue to next page

Thank you for your time!