BIG RED SHARE

CEE 5910 -ENGINEERING MANAGEMENT PROJECT

TEAM -1

MASTER OF ENGINEERING MANAGEMENT – CLASS OF 2017

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Executive Summary

This project deals with the feasibility study of introducing a bikeshare program in the region encompassing Cornell University and the town of Ithaca. The project is a part of the required spring course for the Engineering Management 2016-2017 cohort. The project brings together students from diverse backgrounds and work experiences in order to come up with a real-world solution, which includes aspects of technicality as well as project management. The goal of the project was to conduct an in-depth analysis of introducing a bikeshare program highlighting different constraints, assumptions and barriers to entry. The team has successfully managed to gather strategic insights, which can be useful as a reference study for anyone interested in this kind of project for the future.

The team members divided themselves into three major groups, namely, marketing, operations, and finance. However, they remained in collaboration with each other to provide cross-functional support throughout the length of the project. The project initiated with the marketing team conducting in-depth interviews from Cornell faculty and students and community members, which helped to strategically design a survey to gain insights about the target audience and the usage drivers and barriers. The results obtained from the marketing team were then used by the operations team to model a bikeshare system, taking into account their target audience. The operating team conducted a detailed analysis and planned bike station siting locations, elevation map, weather constraints as well as a rebalancing simulation coded in Python. They also obtained various capital costs from vendors across the globe as well as designed various operating and maintenance procedures as well as liability standards. The financial team formulated and forecasted financial models for the next 14 years and suggested funding strategies for various types of bikeshare businesses.

The result of the project portrayed that a bikeshare system was feasible across the Cornell Campus as well as Ithaca town taking into consideration various barriers. However, a major part of the project was based on assumptions due to the unavailability of previous bikeshare data across the region. Hence, this project can be used as a solid reference for future implementation of a bikeshare program in this region.

Advisor's Introduction

The following report on bikesharing in the Ithaca area is the latest in a series of reports on transportation technologies and systems from the Engineering Management program at Cornell University dating back to 2004, and ranging in subjects from advanced public transportation to plug-in hybrid electric vehicles, battery swapping systems, and hydrogen fuel cell vehicles. It also falls under the heading of reports aimed at developing a sustainable livable community in the Ithaca area and Tompkins County that focus on sustainable energy, buildings, and transportation. This report as well as previous ones can be downloaded at www.lightlink.com/francis/.

Our system for forming engineering management project teams and carrying out projects is the following. At the beginning of the semester, faculty members offer a limited number of project topics, and then the students (who come from a range of engineering and related disciplines) choose their preferred topic and form a team. Thus the team members are not free to independently choose any topic that they desire, and they may or may not have previous experience with the topic that they choose. Instead, the team must draw on whatever experience they have and the engineering management skill set that they have in common to evaluate the technology or system and produce a report.

In the report that follows, the 14-member team has taken on the subject of bikesharing, including an online survey of likely users of bikesharing. They have proposed a phased launch of a bikesharing system, with 8 stations initially growing to 12 stations in a second phase for the combined area in the plain of downtown Ithaca and on East Hill including Cornell University. Initially 56 bikes would be deployed, with the number of bikes growing in line with added stations. Their cost of operations includes a funding stream based on numbers and types of memberships, and an organizational plan for operating the bikesharing business. Lastly their report also contains a sensitivity analysis of cash flow to optimistic or pessimistic outcomes for ridership and operating cost over the proposed 14-year life cycle of the initial investment.

In closing, any statements in this report do not represent the official opinion of the City of Ithaca or of Cornell University. I would like to thank representatives of Cornell Transportation and Mail Services on the academic side as well as Bike Walk Tompkins and Ithaca Carshare on the community side who gave input to this study. While their assistance is gratefully acknowledged responsibility for any errors and omissions lies with the team and with myself as advisor.

Respectfully submitted,

Francis M Vanek

Francis M Vanek, Senior Lecturer

Disclaimer

This project report is made for educational purposes only. This project is only for teaching purposes and under no circumstances shall Cornell University be liable for any indirect, incidental, consequential, special, or exemplary problems arising out of this project.

1. Introduction

In recent decades, bikeshare systems in the United States have been gaining popularity. Bikeshare systems are a sustainable mode of transportation that promotes the wellbeing of the environment and the society. Recent statistics from 2016 portray the increase in a particular type of bikeshare system from 4 programs with 1,600 bikes to 35 programs with 42,200 bikes [1]. Cornell University has researched bikeshare systems in the past. However, its bikeshare project, "Big Red Bikes," was student-run, failed to operate effectively, and was discontinued in 2015 due to many performance issues.

This current project includes, but is not limited to, the feasibility study of a bikeshare system in Cornell and Ithaca. The project serves as a comprehensive study for the implementation of a bikeshare system from scratch to a complete running business model. The study included in this project will broadly integrate three main segments: (1) marketing research for the implementation of a bikeshare system; (2) the financial modeling of the system along with a pricing strategy; and (3) the operational tactics to run a successful system.

This project aims to envision the goals of creating a system that appears to be challenging due to various climatic, topographic, and demographic factors of Ithaca. This project shall deal with the research, planning, identification, and evaluation of such a system, and will consider vital issues such as funding, infrastructure, market availability, distribution strategy, safety, and the smooth running of the transport network within the city of Ithaca and the Cornell campus. Eventually, this study can then be expanded to take into consideration the system being introduced beyond Ithaca as well.

1.1. Motivation

Bikesharing is a growing transportation option in many major cities and universities across the world. Riding bicycles offers a healthier and more sustainable option for commuting across short distances, compared to conventional options such as shuttles and cars. In university campuses with high parking permit fees and few public transportation options, bikesharing provides a cost-effective and convenient solution for transportation. Thus, bikesharing is the most common mode of transit used by students, faculty, staff, and the community across various university campuses in the United States.

To address the need of a bikeshare system at Cornell University, Big Red Share was formed in spring 2017 under the supervision of project advisor Dr. Francis Vanek to study the feasibility of a sustainable bikeshare system at Cornell University and the City of Ithaca. The group was tasked with evaluating the aspects of an "own and operate" model of a bikeshare system at Cornell University and deciding if the project can be implemented in reality, based off of a cost-benefit analysis.

Currently, Cornell University has a 16-month renewable contract for a forthcoming campus bikeshare system that is based on a "bikeshare as a service" model. The group believes that Cornell University is self-sufficient in implementing small scale systems, such as a bikeshare system, and plans to understand what motivated the University to choose a "bikeshare as a service" model over the "own and operate" model of bikesharing.

1.2 Objectives and Goals

Objective 1: Assess the feasibility of a Cornell University and Ithaca bikeshare system based on the following criteria:

a. Interest and demand from local community
b. Realistic funding amount needed to operate the system
c. The plausibility of a self-designed "own and operate" model

Objective 2: If feasible, find the cost-effectiveness of the project.
Objective 3: To use engineering principles learned in the Engineering Management program while working on a project similar to ones that the team members may encounter post-graduation.

1.3 Structure of teams

Marketing Team	Operations Team	Finance Team
Anshul Goel*	Wali Rahman*	Vicki Mermanishvili*
Alec Charbonneau**	Ezgi Demirayak**	Haonan Chi
Pranav Krishna	Matthew Gerstenblitt	Malay Nasit
Abinesh Ravi	Bolun Liu	Angelos Dalamagkas
Okenna Oruche		Eric Sun

*Subteam leader ** Team co-leader

1.4 Team background

Alec Charbonneau:
Alec graduated from Cornell with a B.S. in Mechanical Engineering and Business Minor in May 2016. He grew up in Powell, OH, a suburb outside of Columbus. Charbonneau has worked primarily in the United States, with a summer internship in Chiclayo Peru in 2015. Alec's strengths are primarily in project management, especially within technical fields. With a multitude of engineering group projects at Cornell, he has had much experience. Other skills Alec brings to the group are collaborative skills, data analytics, financial modeling, and research skills. Upon graduation in May, Charbonneau is hoping to land a consulting position on the East Coast of the United States.

Haonan Chi:
Haonan is pursuing her master's degree in Cornell University with her major in Engineering Management. Haonan got her bachelor's degree from Beijing Jiaotong University, majoring in traffic engineering. She interned at Qingdao Sanfeng Road & Bridge Co., Ltd. and worked as an assistant project manager. She also interned at Qingdao Zhongchu Logistic Co., Ltd. and worked as a logistic & sales administration assistant. She learned about roadways, planning and designing a traffic system to make it functional and operational. Also, she learned software including TransCAD, Synchro, MapInfo. So, when it comes to bikesharing, she could help to coordinate the traffic system. She is interested in helping the team with the financial aspects of the project.

Angelos Dalamagkas:
Angelos studied Civil and Structural Engineering at the National Technical University of Athens, Greece. He decided that he wanted to be an engineer thanks to the spectacular bridges and tunnels of mountainous parts of Greece and Europe which, looking through his young eyes, seemed to defy all the rules of nature. The School of Civil Engineering offered a five-year joint undergraduate and graduate program (BSc and MSc), during which Angelos was also working as a private tutor of Mathematics and Physics for high school and IB (International Baccalaureate) students. He has served a nine-month military service, and his aim at that time was to make the most of this experience. Being a member of an elite team of engineers who were responsible for the infrastructure repairs in military camps, Angelos enriched his practical experience and strengthened his decision-making skills. After that, acquiring management skills, which would ideally supplement his technical background, became his priority, so he decided to pursue masters in Engineering Management at Cornell University. The program's diverse coursework and the team project, which he is an active part of is a meaningful experience for him and he is really happy with his choice.

Ezgi Demirayak:
Ezgi Demirayak participated in a dual diploma program in Information Systems Engineering. It was an innovative program administered jointly by the Computer Science department at the State University of New York at Binghamton and Istanbul Technical University. This program provided a unique opportunity for students to spend two years in the United States and two years in Turkey. Students earned a bachelors degree and were awarded two diplomas, one from each university. Through this program she gained perspectives of both the countries on Computer Science, became more adaptive to environmental changes, and obtained a technological proficiency. Currently, Ezgi is an Engineering Management student at Cornell University. She is a co-leader of the project, assisting with the management of team operations and helping to streamline the project's progress. Moreover, she possesses a deep knowledge about the technological side of the bikeshare.

Matthew Gerstenblitt:
Matthew Gerstenblitt was raised in sunny (and rainy) Orlando, Florida, 15 minutes from Disney World. He received a Bachelor of Science in Industrial Engineering from Florida State University in April 2016. Matthew also served as a team leader in his undergraduate capstone project and completed two internships in research and development at a major plastics manufacturer. He is currently an Engineering Management student at Cornell University. Matthew's skills include mastery of Microsoft Office and Publisher, as well as basic C++ and MATLAB programming. He is also familiar with Minitab, Area Simulation, and Tecnomatix. Additionally, Matthew has experience presenting complex engineering project results to executive management teams and understands how to translate technical language to vernacular English.

Anshul Goel:
Anshul is originally from Chandigarh, India. He graduated from L.N. Mittal Institute of Information Technology, India in 2013 with a bachelors in Computer Science and Engineering and later worked for 3 years with McAfee, Inc. and Adobe, Inc. as a software engineer. After the completion of his masters in Engineering Management from Cornell University, he plans to pursue senior software engineering roles. He is interested in optimization models and loves to write computer programs in his free time.

Pranav Krishna:
Pranav is currently pursuing his masters in Engineering Management at Cornell University, specializing in E-Commerce and Product Marketing Insights. An undergraduate in Electrical & Electronics Engineering, he is a technologist at heart. He is eager to solve critical business problems using technology in a creative and innovative way. He has had a unique work experience with a Natural Resources company wherein he worked in remotely located manufacturing plants and successfully juggled between meeting business objectives, negotiating with tribal labor unions and efficiently engaging with senior management. Pranav brings to this project, the skills that he wishes to apply in his career. These include team-management, product marketing and consumer insights, project management and data analysis.

Bolun Liu:
Bolun Liu is a current graduate student in Engineering Management in Cornell who studied Mechanical Engineering at Yale University. He was the team leader in a rocket design and construction project in Yale Undergraduate Aerospace Organization. Bolun worked as a part of the Operations team and his responsibilities included but were not limited to developing strategies for monitoring, rebalancing, and storing that make sure that the bikes are available in the right place at the right time and keep the bikesharing process running smoothly.

Vicki Mermanishvili:
Vicki Mermanishvili is an Engineering Management master's student, specializing in Management Consulting. She completed her undergraduate degree at Cornell as well, but in Biological Engineering with a minor in business. As an Engineering Management student, Vicki has taken several courses in Johnson, such as Managerial Finance, Comprehensive Financial Statement Analysis, Investment and Portfolio Management, and Financial Modeling. She plans to bring the knowledge and skills acquired from these courses to help the team in creating solutions to maximize profitability of the bikeshare project. Additionally, she believes her strong teamwork abilities and attention to detail will be beneficial to the team throughout the duration of the project.

Malay Nasit:
Malay is a graduate student pursuing MEM (MEng in Engineering Management) with specialization in Financial and Managerial applications at Cornell University. He is interested in Global Capital Markets and has also worked as a Marketing Research Intern for 'RubinHaney Capital Management' firm's hedge fund. He did his bachelors in Mechanical Engineering from 'VIT University, Vellore, India'. Here he was associated with Transmission, Go Green, Treasury & Logistics department of university's BAJA SAE team and later went on to lead it's multi-disciplinary team of 24 members as Team Leader. After working on various projects during his undergraduate studies, Malay considers knowledge in Economics (Finance and Liberal Arts) an inevitable factor for decision making for any project big or small (over and above the technical knowledge). This very belief gave him the impetus to get well versed with the Global Capital Markets, with an aim to understand global economies as a whole. It also motivated him to consider pursuing MEM. Malay brings to this project a niche skillset that includes Market Research, Economic Analysis & Valuation (Asset, Company, Project) and Business Development.

Okenna Oruche:
Okenna Oruche is a Cornell University Masters of Engineering student majoring in Engineering Management focusing in both Systems Engineering and Management Consulting. He completed his undergraduate degree at Cornell as well but with a major in Biological and Environmental Engineering. Upon completion of his masters he hopes to either pursue product development or consult and use his engineering knowledge to help businesses implement novel and innovative solutions to the challenges. He has an experience with customer discovery, product development, supply chains and operations. Okenna originally hails from Indianapolis Indiana.

Wali Rahman:
Wali is an international graduate student from India who has varied academic and professional experience in India, UK and USA. Raised in Calcutta, India, Wali went on to complete his undergraduate degree in Mechanical Engineering from Newcastle, UK after which he arrived to Cornell University, USA to pursue his graduate degree in Engineering Management. Wali has a work experience in retail stores, tobacco manufacturing firm as well as a multi-national oil & gas corporation. He has dealt with clients whose demands have ranged from $2 to $10 Million. His current degree focuses in management consulting and finance courses from Johnson School of Management. Wali plans to integrate his prior work experience and technical tools for project management like planning, scheduling and control along with emphasis on the human side which incorporates team-working, managing performance, resolving conflicts etc. Having been a finalist in a start-up competition in one of the top management schools in India, Wali plans to take up the bikeshare project as a comprehensive business idea which he hopes can be pitched out to external clients and eventually implemented for the greater good of the Cornell and Ithaca community.

Abinesh Ravi:
Abinesh was born in Chennai, India, and worked on his undergraduate degree in Mechanical Engineering from Anna University. His inquisitiveness brought him stateside to pursue a Master's program at Arizona State University, where he graduated with a thesis in the additive manufacturing sector. With an active interest in product development and project management, Abinesh is now working on his Engineering Management degree at Cornell University, on the lighter side, he's an advocate for animal rights, plays racquet sports and enjoys stargazing! Abinesh brings into this project his skills and interests in project and team management, financial asset management, data analysis and his working knowledge in Mechanical Engineering.

Eric Sun:
Eric Sun’s Chinese name is Juntong Sun. He grew up in Northeast China where it is much colder than New York State. He graduated and got his bachelor’s degree from Tsinghua University in Beijing, China. He majored in Industrial Engineering. An industrial engineer aims at improving the efficiency of complex system, such as factory, hospital or even Disneyland. To be a qualified industrial engineer, one needs to learn basic manufacturing management skills and certain operational research knowledge. Human factor design is also an essential part of the knowledge base. During 4 years of study, he mastered required mathematical skills and became familiar with several useful software, such as ProE, Plant Simulation, and AutoCAD. He interned at Suzuki motors and Schneider electrics as a supply chain manager. The internships taught him lessons on how to cooperate and contribute in a team. He hopes his technical and financial background would be beneficial to the bikeshare team. The skills Eric will contribute to the team are operational research, stochastic process, supply chain management, and basic managerial finance.

2. Market Research

Just like every other product launched into the market, performing market research played an integral role in doing the feasibility analysis of the Ithaca bikeshare. Market research helped us in understanding the key marketing, operational and financial aspects of already implemented bikeshare systems, the inevitable challenges, and the right approach on how to go about creating a new bikeshare system in Ithaca.

The market research process comprised of two stages, secondary research and primary research. Similar to the typical market research process followed in the industry, the secondary research was done prior to primary research as it provided actionable insights in effectively performing the primary research. A detailed explanation of these steps is as follows:

2.1 Secondary Research

Data collection is a money intensive process. Therefore, before moving with any data collection specific to Ithaca bikeshare, it was important to look for already available research and corresponding data. The objective of this step was to discover relevant insights from both already existing bikeshare systems and ones that were attempted but failed. Hence, we did a thorough case study analysis of the following bikeshare systems.

2.1.1. Case Studies

Citibike, NY

Citibike is New York City's bikeshare system that is the largest in the United States. Launched in May 2013, Citi Bike is available 24 hours a day every day of the year and provides a last mile solution for riders in the highly populated and traffic ridden city. With a sharing based travel economy emerging, Citibike provided a simple and cost-effective alternative to walking, riding a cab or taking the bus, and encouraged short and multi-modal trips. In this system, riders have access to thousands of bikes at stations across the city. It started with 330 stations and 5000 bikes in lower Manhattan and has been growing since then. The design considerations of Citibike were developed with proximity to subway stations, which were primary last mile demand locations.

Financially, the system has three different payment plans on which it operates [2]:

- Single Rides : $4, with additional $4 for additional 15 minutes
- Day Passes: Single day pass (24 hours CitiBike access) costs $12 and a 3 day pass (72 hours CitiBike access) costs $24
- Annual Memberships: A commitment of $163 annual or $14.95/month for 12 months.

Citibike had several problems in the beginning stages. Most problematic was the rebalancing of bikes among the different dock locations. The bike riders overloaded the most popular stations, which rendered other docks without bikes. The Citibike program tried different strategies to overcome this problem such as hiring rebalancing trucks and trailers for the busiest stations. Eventually, Citibike implemented a unique strategy to incentivize the members to relocate the bikes themselves. These people were termed as 'Bike Angels'. The program began with the company sending emails to individuals to drop bikes at a nearby dock and thus earn reward points. This strategy for rebalancing quickly became very successful. Even with the challenges the system faced, the system topped 10 million rides in 2015.

Capital Bikeshare, Washington DC

Capital Bikeshare is a program jointly owned by District of Columbia, Arlington County, VA, the City of Alexandria, VA, and Montgomery County, MD, and operated by Motivate International, Inc. It has over 351 stations, more than 29,000 members and 250,000 trips per month or 10.5 million trips in total since its inception. Financial assistance was provided by the county for poorer members of the society, and this increased adoption of the bikeshare system. The District of Columbia is educating students in schools about riding bikes and institutionalizing this education to make more and more people choose biking as a mode of transport.

The program offers more than 350 stations across all locations [3].

A financial breakdown of the membership and ride costs are given below:

- Single Rides: $2 (for 29 min), $4(for 30-59 min), +$4(60-89 min) and 90+min (+ $8 per each additional 30 minutes)
- Day Passes: $8 (for 24 hours), $17 (for 3-day pass), $10 initial fee +$7/day (Day Key membership)
- Annual Memberships: $85 or $8 per month with annual commitment.

In November 2016, a study conducted showed a reduction in traffic congestion of 4% in Washington D.C. due to Capital Bikeshare. Capital Bikeshare programs were very popular and resulted in an average savings of $631/year. 70% of its members claimed that they use bikes because it was a fun way to travel. Government incentives and education went a long way in sensitizing and acquiring potential users. About 20% of the business perceived a positive impact on sales and 70% reported a very good impact on the neighborhoods.

Indigo Bikeshare, Philadelphia

Indigo Bikeshare was launched by the City of Philadelphia in 2015 as a new mode of transportation. This program is a great example of a heterogeneous ownership and operations model. The program started with 600 bikes and 60 bike stations, which are owned by the City of Philadelphia, and plans to reach the 1800 bikes and 180-bike station target. The planning and management of the bikeshare system is done by state's Office of Transportation & Infrastructure Systems. Operations, on the other hand, are managed by a Philadelphia-based business named "Bicycle Transit Systems". The typical job functions undertaken by "Bicycle Transit Systems" include maintenance, marketing and customer service. Indigo Bikeshare system registered 180,000 rides in the first 100 days of operation. The following are the key insights that we derived from this system [4]:

- The first bikeshare program with a major mass media program that included TV and Billboards advertisements.
- It employs an additional cash payment option for people without a credit card, which can be purchased at stores similar to 7-Eleven in Ithaca.

Cornell University's Big Red Bikes

A bikeshare program at Cornell University was first started in 1980, but there was no accurate tracking and maintenance system in place and which primarily led to its failure. The library staff handing the system were not given sufficient training as well which further led to a failure on the operational front. There was another attempt again in 2011 after learning from these errors. These bikes were free to use and were circulated from the libraries, where riders had to pick up the bike, keys and helmet from the circulation desk of one of the libraries and then return it before the library closing time on that day. Spark Mobility software was used to keep track of the riders and the bikes to ensure ease of access and accountability. Members were allowed to ride for about 25 hours of free usages every week and had to pay an incremental amount of $5 per hour for 5 hours and $20 per hour thereafter. The program did not operate during the winter, and re-opened in March after temporary shutdown in November. There were issues encountered with insurance, liability and risk, which were addressed with the implementation of a liability waiver that had to be signed before the bike was used.

The program shut down in a couple of years due to problems. The library staff were not adequately trained to inspect bicycles for damage and use but were given this extra responsibility. The program itself was located at the library, which caused accessibility issues and reduced demand. The third problem was that the system functioned only during the library hours, which did not work into many riders' schedules.

2.1.2 Primary Research

The purpose of primary research was to collect specific data and insights pertaining to Cornell University and Ithaca bikeshare. We accomplished this through the following two channels:

1 In-depth Interviews
2 Market Survey

2.1.2.1 In-depth Interviews

As a part of in-depth interviews, we interviewed a group of 5 people including past and current students and faculty from Johnson School of Business and School of Civil and Environmental Engineering. The duration of each interview was between 45-60 minutes and the questions script used to conduct the survey can be found in the appendix. The purpose of the in-depth interviews was to collect qualitative data pertaining to the bikeshare experience of the interviewees in general and their thoughts about a bikeshare system in Ithaca. The interviews helped in getting the following insights which further guided the design of the market survey, and led to the following observations

1. We should focus more on the undergraduate population as they are large in number and can have longer commitments with the system because of their longer program duration. Among the undergraduates, the freshmen and sophomores should be focused more as compared to juniors and seniors.
2. On a similar note, don't focus very much on graduate students especially business school students because majority of them are present for one year and are mostly busy with their curriculum.
3. Most of the interviewees expressed their concerns about the winter months and said they find it unsafe and inconvenient to ride bikes in the winters. Safety is a concern because of the slippery roads and the snow. Inconvenience primarily stems from the discomfort one would have in riding bikes with their snow boots and winter jackets on.
4. The prices of the bikeshare should be comparable to the TCAT buses if not lower. Otherwise, TCAT buses would be preferred over the bikes owing to the comfort and safety offered by buses.
5. Some of the interviewees believed that not many people will see a point in riding bicycles unless they

believe in sustainability and health benefits. So the bikeshare system should marketed by keeping those objectives in mind.

6. One of the unique selling points of the bikeshare system as identified by one of the interviewee was that it could make you reach places not accessible/connected by TCAT buses. That could be another strategic insight in devising the operations strategy.

2.1.2.2 Market Survey

After getting qualitative insights about bikeshare for Ithaca, we created a 17 question survey that was circulated through various channels including email and social media among the Cornell and Ithaca population. The survey focused on general behavioral questions, demographics, willingness to pay, usage preferences and barriers. The survey captured 617 responses and the following are the insights that we derived from the data.

Demographics

Ithaca is a small town with people who differ in occupation, residential location and transportation preferences. The way the survey was circulated, it was not intended to be a representative of the entire Ithaca population, but the demographics captured by the survey indicate responses from nearly 47% student population, 23% non-student Cornell population and 30% non-Cornell population. However, we believe that the data for the non-Cornell population does not significantly represent the entire non-Cornell Ithaca population, so the survey data analysis revolves more around the Cornell population in particular.

Occupation

The survey also had a question in which the respondents were asked about their occupation. As shown in Figure 2.1, the results indicated that about 47% of the respondents were registered as students, 23% were teaching faculty or college staff, about 3% were in the production/construction or crafts industry, about 2% were involved in sales. Around 25% of the respondents practiced diverse occupational or professional roles.

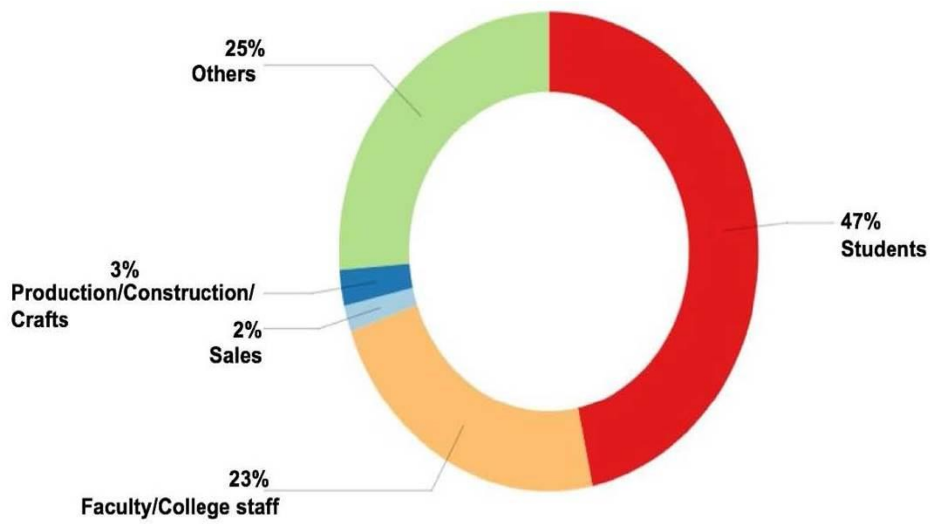


Figure 2.1 Occupation

Thus, the respondents were primarily students and staff of Cornell University. This insight communicates that the product marketing strategy should be effectively tailored and streamlined towards these groups for effective customer conversion. In other words, the target segments should be the major respondents of the survey i.e. students and faculty at Cornell University.

<u>Residence Locations</u>

To understand the spatial distribution of our target market segment within the city of Ithaca, the survey asked the respondents to identify their current residential locations. As shown in Figure 2.2, about 21% of residents live in Collegetown, followed by 20% who reside in Downtown Ithaca. 15% of the residents live in the North Campus while about 10% live in the West Campus of Cornell University.

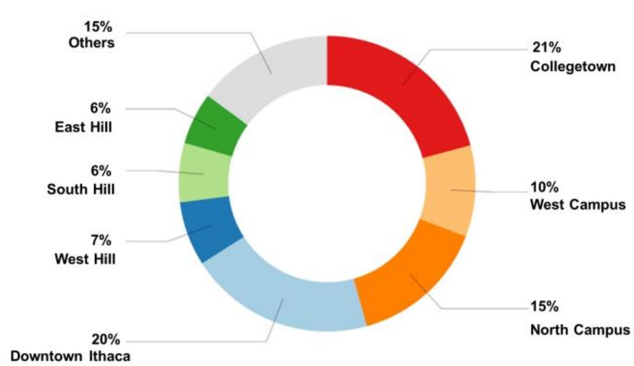


Figure 2.2. Residence location

Since a majority of the respondents live in areas such as Downtown, Collegetown, West Campus and East

Campus, the distribution of physical marketing campaign through posters and flyers could be carried out in these locations to achieve maximum outreach. Visibility of our campaigns and marketing material is of paramount importance to justify the return on investment on the marketing expenses. On a separate note, these locations are also potential locations for positioning bike docks.

Currently Used Modes of Transport

People taking the survey were also asked to select their currently used modes of transport within the city of Ithaca. About 30% of the respondents preferred walking, around 25% traveled using their own cars, followed by 25% using Ithaca's TCAT bus service and 15% using their own bicycles respectively. About 5% are using a different mode of transport. This was a multiple choice question that asked the respondents to choose all the modes of transport used by them. The percentages in the graph below indicate the share of the preferred selections received for a particular mode of transport among the total selections received by all the modes of transportation.

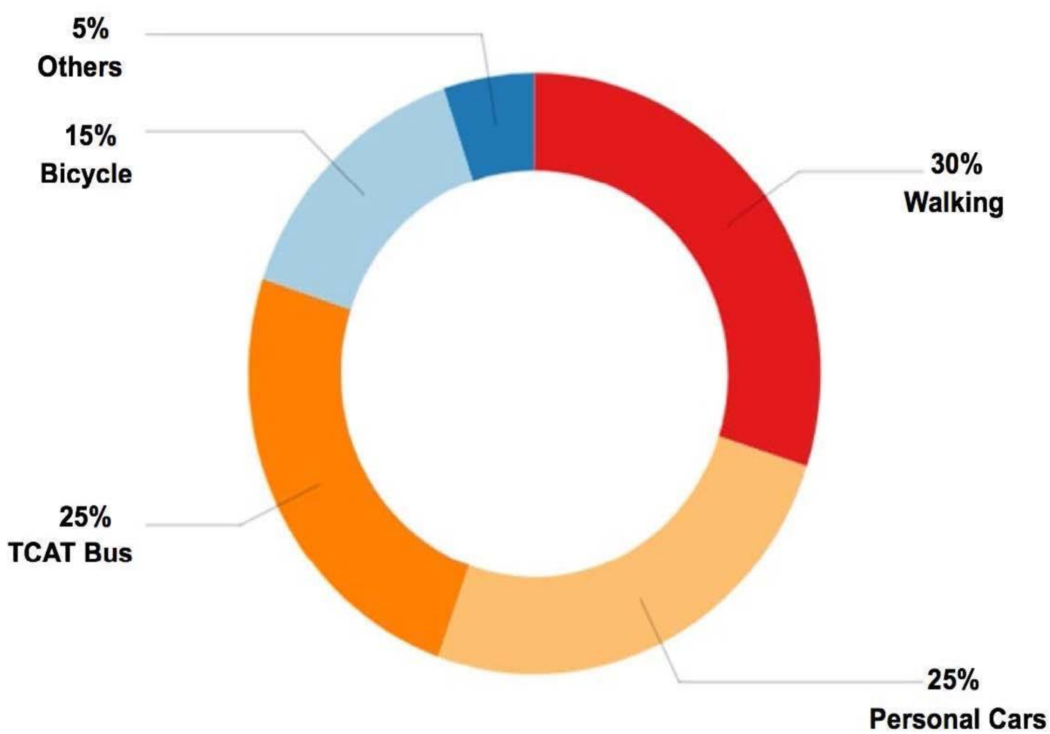


Figure 2.3 Currently Used Modes of Transport

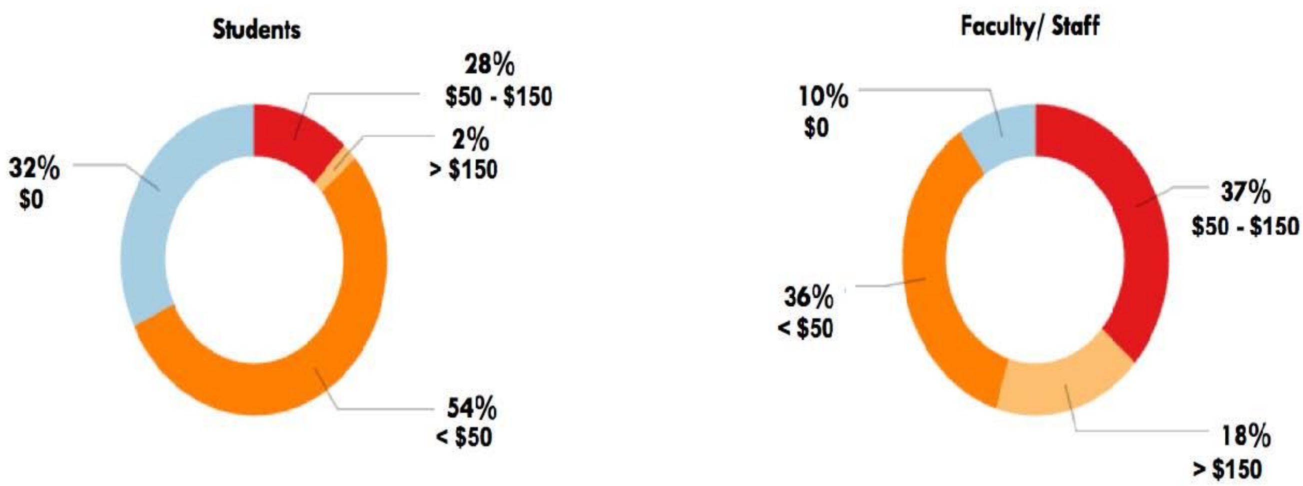
The most used modes of transport include walking, TCAT bus service, personal cars and personal bicycles. While the people who generally walk present a potential customer segment, the other transport modes are a direct competition to our bikeshare service. They set a benchmark for the attributes against which the Ithaca bikeshare needs to be developed and marketed to attract the customers.

Current Monthly Transport Expenditure

As explored in the previous sections, the residents of Ithaca differ on many fronts. One very important aspect that the survey needed to capture is their expenditure patterns to understand the financial side of this feasibility study.

Based on the occupational demographic data, it was determined that college students and faculty/staff constituted the primary market and their current monthly expenditure patterns were elicited through the survey. Around 32% of the student respondents claimed to not spend any money on their transport followed by about 54% who spend less than $50. 28% spent between $50 and $150 and around 2% respondents spend greater than $150. Similarly, 10% of the non-students don't spend any money on transport followed by 36% who spend less than $50. 37% spend between $50 and $150 and about 18% spend over $150 on their transportation needs. The results are shown in Figure 2.4.

One of the major reasons why 54% of the students do not appear to spend any significant amount on their current monthly transport options is the provision of TCAT bus service free of charge. All the first year students have free access for the entire day and rest of the students have free access in the evenings. However, a significant disparity can be observed between the students and the faculty. Students generally live with other students or alone and use relatively less expensive modes of transport. Faculty and staff on the other hand are residents of Ithaca living



further away from the campus with their families, which significantly adds to their transportation expenditure.

Figure 2.4 Current Monthly Transport Expenditure for Students and Staff

Awareness of Bikesharing

Survey respondents were also asked to state their level of awareness of bikesharing systems in general. About 36% of them are aware and have used a bikeshare program before. Around 57% are aware but haven't used a bikesharing system, while around 7% aren't aware of and haven't used any system.

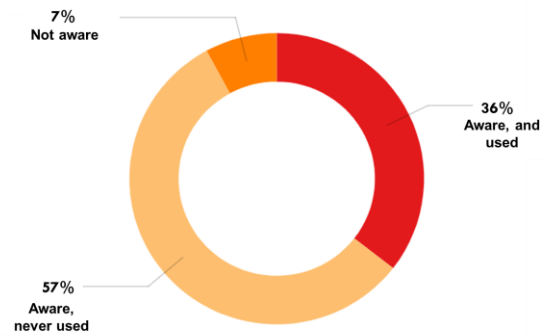


Figure 2.5 Awareness of bikesharing

High awareness levels among respondents gave a strong indication that a significant effort doesn't need to be spent on the dissipation of information regarding bikeshare systems and educating the potential customers about its benefits for their conversion. Instead, the entire marketing effort can be spent on promoting the bikeshare over its competitive modes of transport.

Willingness to use bikeshare

For a bikesharing system to be feasible, Ithaca residents were asked about their willingness to use a bikesharing system, if implemented. A convincing 73% were willing to use the system, followed by 24% who were indifferent about usage if implemented. About 3% of the respondents were not willing to use the system if it was implemented in Ithaca.

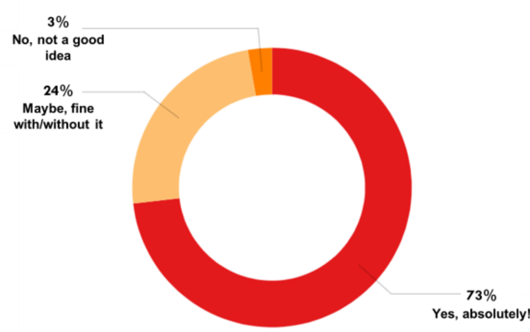


Figure 2.6 Willingness to use bikesharing

The metrics presented here can be used to calculate the size of the market that is willing to use the product. Nielsen Bases has aggregated data on discount rates based on consumer insights over many years. When companies don't have access to the consumer insight data from Nielsen, the 80/30 is used as a thumb rule for discounting. This 80/30 rule can be used to calculate the market size for the Ithaca bikeshare as well.

Market size = 80% (Yes, Absolutely) + 30% (Maybe, fine with/without it)

= 80% (73%) + 30% (24%)

= 65.6%

Thus, 65.6% of the surveyed population will use our product upon introduction.

Preferred Membership Plans

To determine consumer behavior towards usage, the respondents were asked to select their preferred membership plans (payment schedules). A majority of 50% respondents wanted to use the pay-per-ride plan followed by a 21% annual plan preference and a 16% monthly plan preference respectively. As shown in Figure 2.7 are the results of this data.

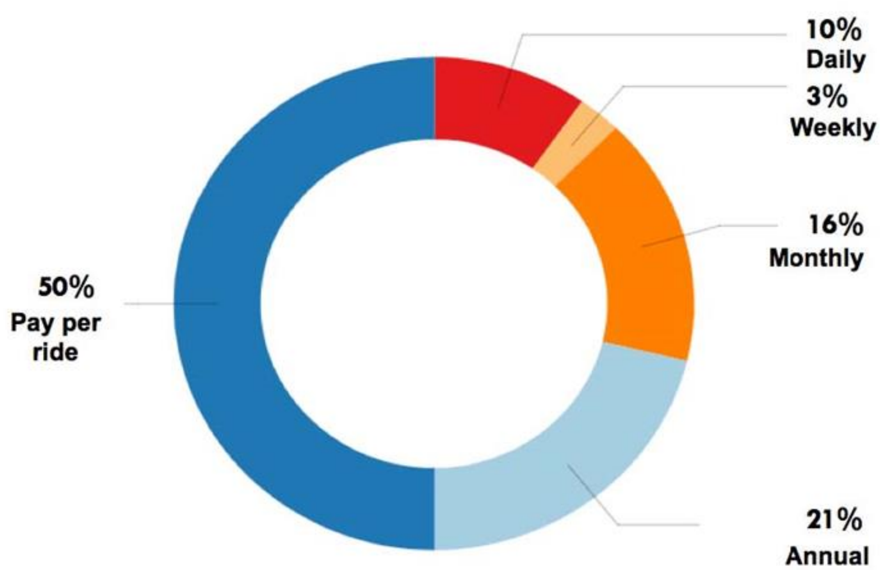


Figure 2.7 Preferred membership plans

The insight that we received from this data was that the most preferred plan is 'pay per ride' followed by the 'annual' membership. This is significant data from a financial and operational point of view in deciding the optimal price points to ensure a breakeven revenue stream while also making Ithaca bikeshare appealing to the customers who have other transportation options.

Willingness to Pay for Preferred Membership Plans

To effectively develop the pricing models for the preferred membership plans of the target segments, respondents were asked to choose an amount they would most likely pay for their preferred membership plans. This data was structured and sorted, after which the averages were determined and are plotted in Figure 2.8.

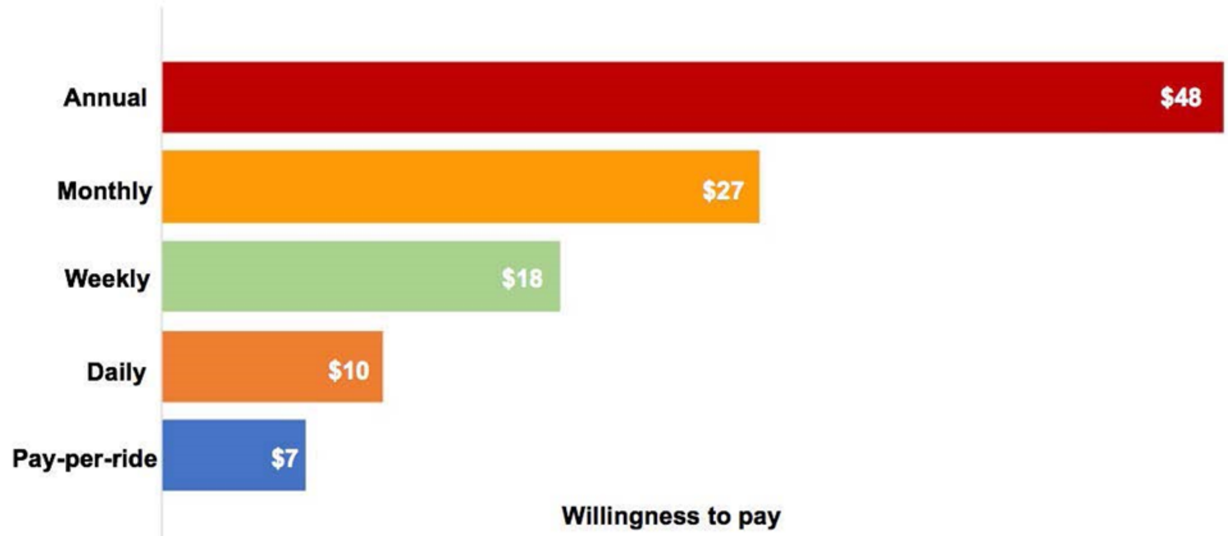


Figure 2.8 Willingness to pay for plans

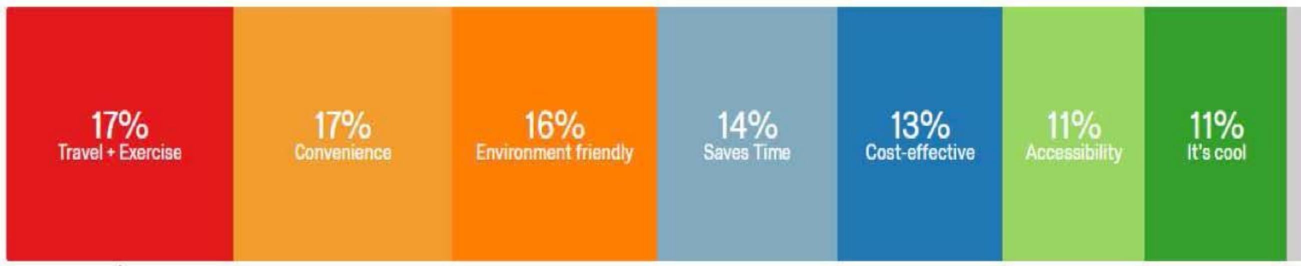
These results can be looked at in conjunction to the preferred membership plans. The values provided for each membership plan is an average of preferences provided by the survey respondents. The survey respondents who prefer a 'pay per ride' plan would use the system if it was priced around $7. Similarly, $48 is the preferred average price for the annual membership and $27 is the preferred average price for the monthly membership.

Usage Driver and Barriers

All the products in the market have factors that drive their market success and some that inhibit its widespread acceptance. In order to understand the potential usage drivers and barriers, the survey respondents were asked for the factors that will motivate them to use bikesharing and the factors that will prevent their use of bikesharing in Ithaca.

Usage Drivers

Based on the survey response, about 34% of respondents would use the system for travel and exercise, and also because it is convenient. A sizable number of respondents (16%) think of the system as an environmentally friendly way to travel and about 14% believe it saves their commute time. The other respondents find the system to be cost effective, accessible and perhaps has a coolness factor associated with it.



Based on these results, the marketing team can provide more weightage to travel, exercise, convenience, environmental friendliness, and time effectiveness as the base for structuring the content around marketing campaigns. Cost-effectiveness, accessibility and the coolness factor can also be used, but with a limited weightage. An interesting A/B testing opportunity can involve a combination of these attributes to a survey group to understand the most effective marketing mix.

Preferred Usage Seasons

Ithaca has a variable weather pattern with some patches of inclement weather, thus for the bikeshare system we sought inputs from the potential customers to determine the operational period. An equal percentage of respondents would like to use the system during fall, spring and summer, but a very low percentage wouldn't mind using the system in winter as well.

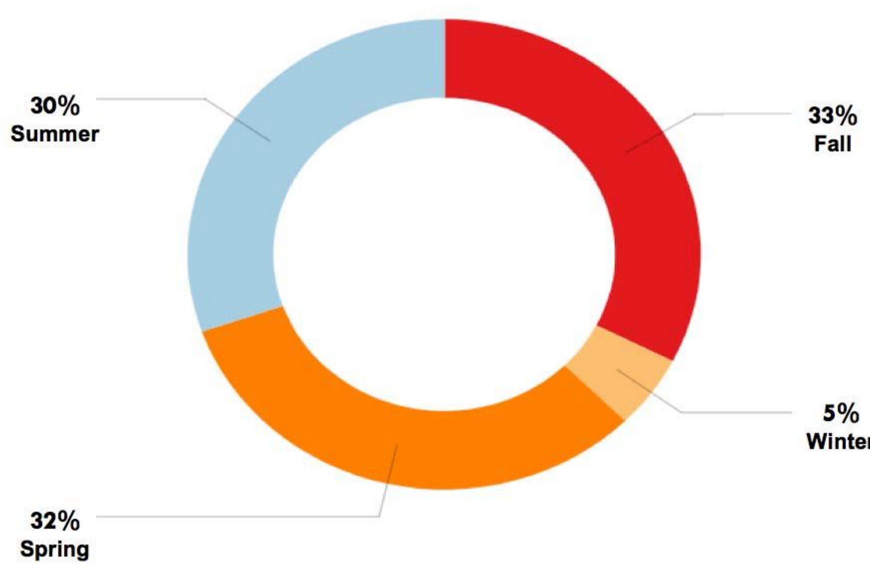


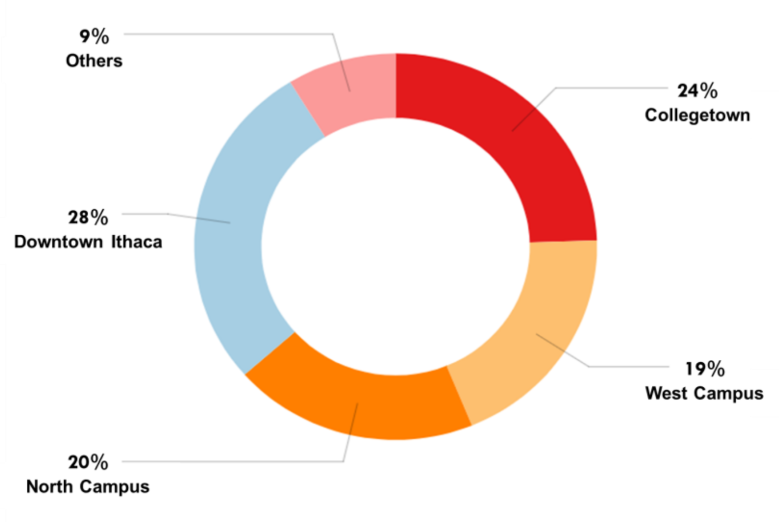
Figure 2.10 Seasonal preferences for bikeshare usage

Since it is evident that the customers would use the system most frequently during the summer, fall and spring seasons, the marketing team explored the motivations for seasonal bikesharing use and tailored marketing content to attract more ridership during those periods. An additional insight received through the survey's post launch question database inquired about the variable usage of the system during certain rainy, windy or hot days. It is understandable that these cannot be predicted with accuracy but will require an iterative learning approach. The marketing team can devise demand generation programs like leisure riding or cause based riding programs, creating and promoting biking clubs, etc.

<u>Preferred Bike Dock Locations</u>

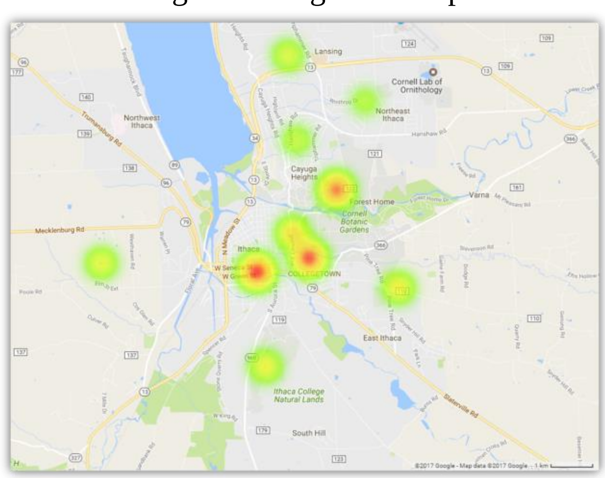
Survey respondents were asked to select areas in Ithaca where they would prefer to see the bike docks being placed. About 28% would prefer their docks to be placed at Downtown, followed by about 24% who would like to see docks at Collegetown. About 20% people would like to place docks at the North Campus and about 19% at West Campus. These results have been shown in Figure 2.11. A heat map with these locations was created using Google's Fusion Tables and shown in Figure 2.12.

Figure 2.11 Preferred dock locations



The preferred locations for bike docks show that customers are frequently visiting these areas due to presence of shopping, dining and residential areas etc. Promotional events can be focused around these areas to increase the visibility of the system. These results also give meaningful inputs for a demand simulation model developed to understand the operational nuances of the system.

Fig.2.12 Usage heat map



Perceived Usage Barriers

A good number of the existing bikeshare systems have barriers to usage, which depends on the customer as well as the location and the associated components. Survey respondents were asked to select attributes that might dissuade them from using the bikeshare system. An equal number of people suggested that the weather conditions and Ithaca's terrain would be a huge hindrance for convenient usage of the system. About 17% see safety being an issue while about 14% are not satisfied with the road conditions. 10% of the respondents suggested that there were insufficient bike lanes, which was quite insightful.

Fig.2.13 Perceived usage barriers

As a part of the future work, these usage barriers need to be addressed which otherwise might deter potential customers from adopting the system. For unpredictable weather conditions, software systems can be developed that give text based weather updates to riders when they are in possession of the bike. The second issue of terrain can be addressed by educating riders using the elevation model developed, as is presented in the operations section of this report. Route optimization options can also be provided to riders to help them take advantage of the terrain. Third, safety can be addressed by promoting bike safety programs to teach interested riders how to avoid injuries while riding bikes and by providing safety gear with the bikes. Finally, the issue with the condition of roads and insufficient bike lanes can be discussed with the Tompkins County administration and Ithaca Mayor's office.

3. Operations

3.1 Organization Structure

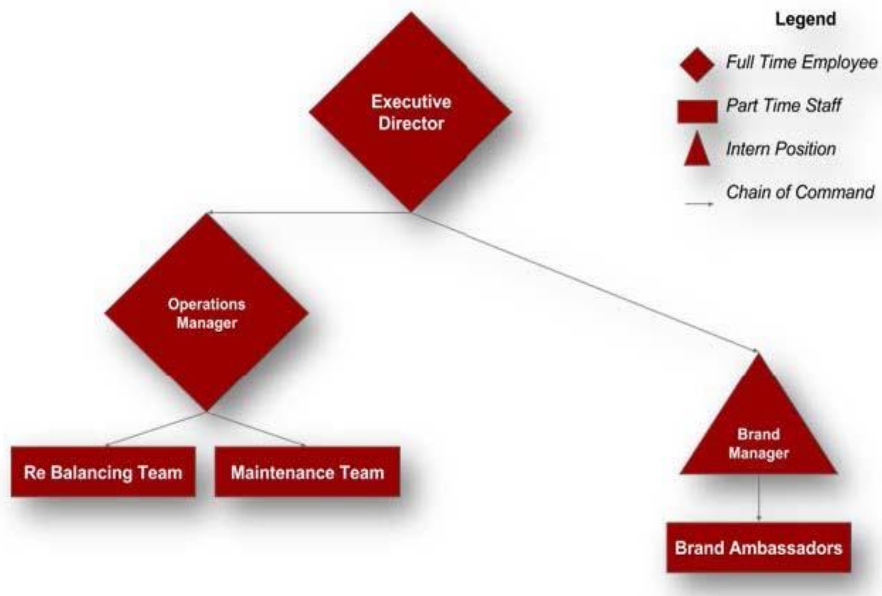


Figure 3.1: Organizational Hierarchy

3.1.1 Organizational Hierarchy

The company will use a fairly simple organizational model. The chain of command would originate from the Executive Director. This person would directly oversee both the Operations Manager and the Brand Manager (Intern). The Operations Manager would manage the both Rebalancing and Maintenance teams. Although the Brand Manager will be a student, they will report only to the Director and work in conjunction with the Operations Manager to keep the constituency consistently updated. The Brand Manager will also manage a team of Brand Ambassadors to advertise during opening/closing and any other promotional periods via printed materials, social media, tabling, quarter cards and word of mouth.

The high priority tasks that will be required to maintain the system will lie with the Director and Brand Manager. They will need to ensure two things: that the company has sponsorship from year to year and that there is an increase in subscriber density throughout the maturation of the system. On a more operational (day-to-day) level, the Operations Manager and his/her two teams should strive to keep customer satisfaction high by ensuring a consistent, reliable, and safe service.

3.1.2 Employee Descriptions

The company will be managed by the Executive Director and Operations Manager, who will both work fulltime.

Executive Director -$70,000/year

The Executive Director would be responsible for the overall management of the program, but more specifically would handle the fiscal documentation. They would aid the Brand Manager (Social Media Director) in acquiring and maintaining sponsorship and advertising and finally they would provide director oversight to the Operations Manager.

Operations Manager -$60,000/year

The Operations Manager would be held responsible for the daily logistics including the maintenance of the bikes, kiosks and docks, rebalancing of the bikes, and any instances of theft and/or property damage. They would oversee a team of bike maintenance & rebalancing.

Brand Manager (Intern) -$17/hour

The Brand Manager would be primarily responsible for acquiring and maintaining sponsorships and advertising. The Brand Manager would also maintain the social media pages and alert the ridership of any issues that may arise the bike system's infrastructure. They would oversee a team of brand associates.

Rebalancing Team -$10/hour

For rebalancing, we aim to hire students from Student Agencies. We estimated weekly hour as 8 hours per week during the period of the program is operational, yielding annual hours of 400. The hourly rate will be $10/hour and it results to an annual salary of $4,000.

Bike Maintenance Team -$10/hour

This team would have members that work in the warehouse completing major repairs and the team would also have members ready to be deployed on the street for minor repairs as needed.

Brand Ambassadors -$7.50/hour

The brand ambassadors would hand out flyers and table for promotional advertising as needed.

3.2 Locations

3.2.1 Initial Locations

The vital components of the bikeshare system are the rebalancing expenses, the personnel structure, and the electronic dock interface. The locations of the docks within the system are critical to its usage, expenses, ability to build subscriber density, and impact on sustainability.

In the revamped Cornell Big Red Share, we plan to begin by setting up eight dock locations. Four of these docks will be housed on Cornell's campus. These locations include Appel Dining Hall, Sage Hall, Noyes Recreation Center, and the Cornell Dairy Bar, which are depicted in Figure B. The other four will be placed throughout the City of Ithaca. More specifically, one will be placed in Collegetown next to the newly built Greenstar Co-op, another in Fall Creek at the Cascadilla Trail base, in the middle of the Ithaca Commons, and another at the Greenstar Co-op located along south Meadow Road just below the Commons, depicted in Figure 2. In Figure 2, initial dock locations are written in white and growth locations are written in red.

Appel Dining Hall

Bus stop for the TCAT Routes 82 and 92.

Locations Benefit: Directly adjacent to one of the dining halls and the only gym on North Campus utilized by a mixture of Cornell faculty, students, and Ithacans. Buses are often filled at this point. Many lowerclassmen find themselves both late and having to walk to class. This bike stop would allow them a quick alternative to get to class on time.

Layout Type: Double sided/Open-spaced dock

Sage Hall

Bus stop for the TCAT Routes 10, 20, 21, 30, 31, 32, 36, 37, 40, 41, 43, 50, 51, 52, 53, 65, 67, 83, 90, 92

Locations Benefit: This stop could be perceived as a focal point for campus. Upson, Sage, the Statler Hotel and Day Hall are all housed around this stop. There is often a mixture of busy Cornell faculty, staff, graduate students, undergraduates, and Ithacans commuting to the Mall, Downtown, East Hill Plaza, Cayuga Heights, and Lansing.

Layout Type: Standard/Open-spaced dock

Noyes Recreation Center

Bus stop for the TCAT Routes 36, 70, 72, 83, 92, 93

Locations Benefit: This stop is major intersection for Cornell's Greek community, West Campus community, and those who live down the hill bordering Ithaca High School. More importantly, it is the last stop for users prior to having to surmount Libe Slope. Often this portion of Cornell's community is unable to find consistent transport to both Collegetown and North Campus, especially on nights and weekends. This stop would allow them to get to these locations without the anxiety of missing the bus.

Layout Type: Angled/Open-spaced dock

Cornell Dairy Bar

Bus stop for the TCAT Routes 17, 20, 21, 31, 36, 37, 40, 41, 43, 51, 52, 53, 65, 67, 75, 81, 82, 83, 92

Locations Benefit: This is the hub for east campus and the connection point for the Veterinary School. Many students also find themselves having to reach their classes in obscure locations on this side of campus. The bikes would provide a relaxed conduit for travel.

Layout Type: Standard/Open-spaced dock

Greenstar (Collegetown)

Bus stop for the TCAT Routes 30, 32, 51, 70, 72, 90

Locations Benefit: This stop would cater to the Collegetown community. Many of the buses in this area run in intervals of 30 minutes to an hour. Having the dock at this location would provide a convenient and consistent means of transport to and from campus for students living in the area. It is also important to note that the constituency of the Greenstar Co-ops would be the target user for the bikeshare.

Layout Type: Double Sided/Open-spaced dock

Fall Creek

Bus stop for the TCAT Route 10

Locations Benefit: This stop would cater to the many Cornell graduate students and professionals that call the Fall Creek area home. The bikeshare stop would allow them flow freely from Cornell Campus, the Commons. The ability to move to the previously noted locales would be especially impactful due to the absence of the 10 route on weekends and nights.

Layout Type: Double Sided/Open-spaced dock

Ithaca Commons

Bus stop for the TCAT Routes 10, 11, 13, 14, 15, 17, 20, 21, 30, 31, 32, 36, 37, 40, 43, 51, 52, 53, 65, 67, 70, 72, 74, 75, 90

Locations Benefit: The commons are the heart of the city of Ithaca, connecting both IC and Cornell students to the greater Ithaca community. The city center holds numerous annual festivals, lodging, local restaurants and municipal offices.

Layout Type: Standard/Open-spaced dock

Greenstar (Route 13)

Bus stop for the TCAT Routes 21

Locations Benefit: This is the farthest stop. It would sit along Route 13 and provide a means for those bordering West Hill to make their way towards the commons, campuses and etc. Again, it is important to note that the constituency of the Green Star Co-ops would be the target user for the bikeshare.

Layout Type: Right Angle/Open-spaced dock

3.2.2 Growth Locations

As we increase the numbers of bikes in the system and derive flow data from the boomerang dashboard. We will open docks and the locations listed below. The order of these locations roll out would be directed by user feedback that will be gathered in everyday operations.

Expansion would not only occur through the addition of new stops but also through increasing the number of bike docks at each location. These additions would once again be implemented by iterative analysis gathered via the boomerang dashboard. Dock locations in the geographic regions of the network are the following:

North Campus

- Robert Purcell Community Center
- Thurston Bridge
- A Lot (after gauging employee feedback)

Central Campus

- Bailey Hall
- Ives Hall
- Arts Quad Libraries
- Engineering Quad

East Campus

- Veterinary School
- Teagle Hall

West Campus

- Stewart Avenue and University

City of Ithaca

- Southside Community Center
- Science Center

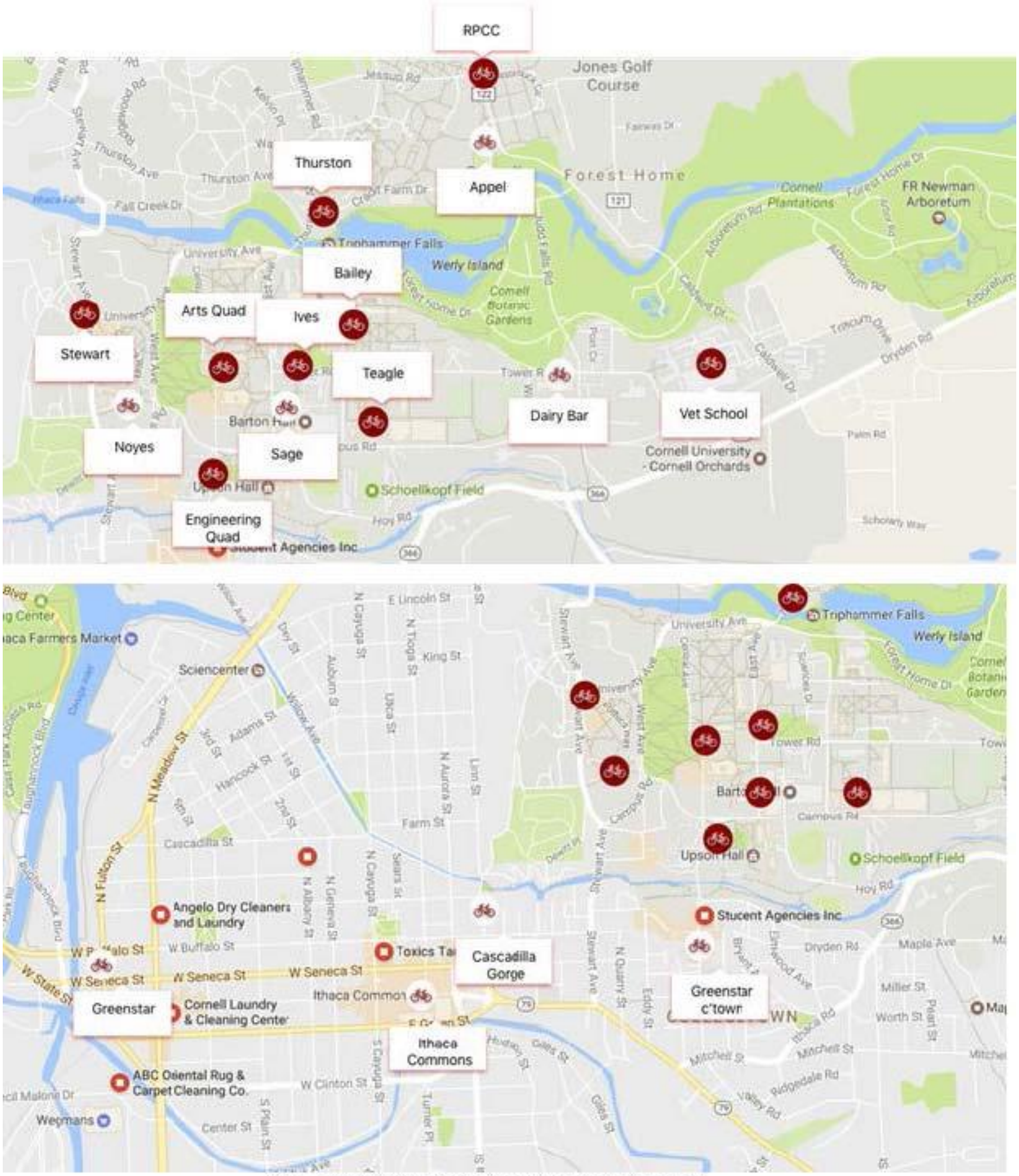


Figure 3.2: Map of Big Red Bikeshare Location

3.3 Central Facility

We plan to hire a facility close to the city center which ideally would be a centralized position to visit all locations. The facility acts as the focal point for business side of the system. The facility will incorporate office space as well as the warehouse and workshop. The office staff shall be equipped with their day-today office furniture as well as equipment. The office would also act as a ticketing office for cash based users. Having a warehouse would allow us to store the bikes during winter which would save bicycle storage costs. The warehouse would also incorporate the workshop for in-house maintenance team. The in-store maintenance staff would repair any damaged bikes which have been brought in for major overhaul or repair. Ideally, the space would be large enough to act as the centralized facility. We aim to keep the accessories inventory at an optimal level. One such location targeted for this business is in the zip-code 14850. The cost of renting this facility, including parking space for the two vehicles (rebalancing and maintenance) ranges between $1,000 and $1800 per month including the utilities [5]. These costs may further drop in case we aim to shift to locations outside the downtown, more towards Route 13.

3.4 Overhead Cost

As mentioned above we will have two motor vehicles housed at the facility: A 15 foot truck that would be utilized for rebalancing and a pickup truck that could be dispatched for on-street maintenance. They would cost approximately $15,000 each. We would also outfit our staff with two Microsoft Surface laptop for the Executive Director and Logistical Coordinator to conduct financial and operational tasks. These would cost approximately 600 dollars each.

3.5 Hardware and Capital Infrastructure

3.5.1 Kiosk Layout

After selecting locations, it is important to adjust the dock set up to meet the needs of the specific location. The National Association of City Transportation Officials notes that the docks should be selected for each location based off of the following criteria: Accessibility & Convenience, Safety, Operational Feasibility, Environmental Enhancement, and Streetscape Hierarchy [6].

Accessibility & Convenience is defined as the ability for system consumers to find and utilize the bikes at any time. Safety within the context of the dock means that the dock is a relief valve for the city's current transit bottlenecks. Operational Feasibility means that the docks should operate within the limitations set by the city's current infrastructure, personnel and resources. Environmental Enhancement speaks on the dock having a beneficial effect on the aesthetics of its surroundings. Finally, when considering Streetscape Hierarchy the dock should shift unneeded placing, but not inhibit the functionality of more major transit infrastructure.

For each dock will be aim to install the most aesthetically pleasing and functional layout for the surrounding environment. The specifics for each of our starting locations are listed above in the *Locations* section.

Figure 3.3: Picture of Bay Area Dock Kiosk

3.5.2 Kiosk Technology

Due to a combination of wanted to include a demographic that is not tech savvy we ultimately decided not to develop a customized website for an application for the bikeshare. We aim to use Cornell University's website and Tompkins County website as mediums for membership sign ups. By utilizing the digital infrastructure we believe that more people will be converted to system users. This will also automatically decrease our marketing cost because we will not need to try to direct people to a new website we created. Moreover, we will not need an application either because we thought it would be a burden for customers to download an application just to use our system. Instead of included a high tech approach to each of our docks we decided to plan the system with a low tech perspective. The kiosk on each dock will allow user to rent bike via their Cornell ID's, Credit or Debit Card. Users who would like to pay with cash would have to do so at set locations i.e. Seven Eleven or CTB in Collegetown or one of the campus libraries after providing a state ID or driver's license. The quote which we obtained from *Kiosk Information Systems* estimated the cost as $3,000 [7][8]. The advantages of kiosk systems are their ability to control access, streamline maintenance and reduce theft.

3.5.3 Bike Technology

Our major criteria when selecting the bikes was the safety and reliability of the bikes in all weather conditions. Since Ithaca has a lot of hills, we made sure that the bikes have intuitive braking system, puncture resistant tires to prevent flat tires and gears and shifters that are sufficient to use on hills. We aimed to have bikes that are cost efficient, therefore one of our crucial considerations was the low-maintenance of the bikes. Hence, we selected bikes that have fenders and in order them to be less affected by the dirt and grease. For the safety of the riders we ensured that our bikes have reflectors, lighting system and flasher. Lastly, the bikes we chose are compatible with bus racks. Sample prices for the bikes were obtained through wholesale sources [9].

We estimated that the life expectancy of a single bike using the method discussed by Kimberly Ong. In our system if a person transports maximum 6 miles every day (365 days) for 4.5 years, then the life expectancy of a bike is assumed to be 9500 miles. We will have 4 deployment phases of our project. In the first phase we will implement 56 bikes to 8 designated docks. This is a onetime cost and is our starting capital. The cost is significantly higher than buying a consumer bike because we are interested in long term operating cost that will be lower after the deployment.

Figure 3.4: Boomerang Tracking Device

3.5.4 Anti-Theft Mechanisms

In an effort to provide a quality experience to our riders, it is essential that there is consistency between the designs of bikeshare systems in a city. As a result, for the locking mechanism of our bikes, we decided to implement a mechanism that is similar to Zagster's mechanism. This will help users to adapt to our system more quickly as they will be accustomed to use our system. We thought that consistency separates a haphazard experience from a polished one. There will be a docking cable from the station into the port on the ring lock. However, we will not lock/unlock using a mobile application. We will only implement the mechanical part of their locking system. User will slide the ring lock's tab all the way down. Then, the rider will wrap the on-bike cable around the rack. Finally, the ride will end by inserting the cable securely into the ring lock.

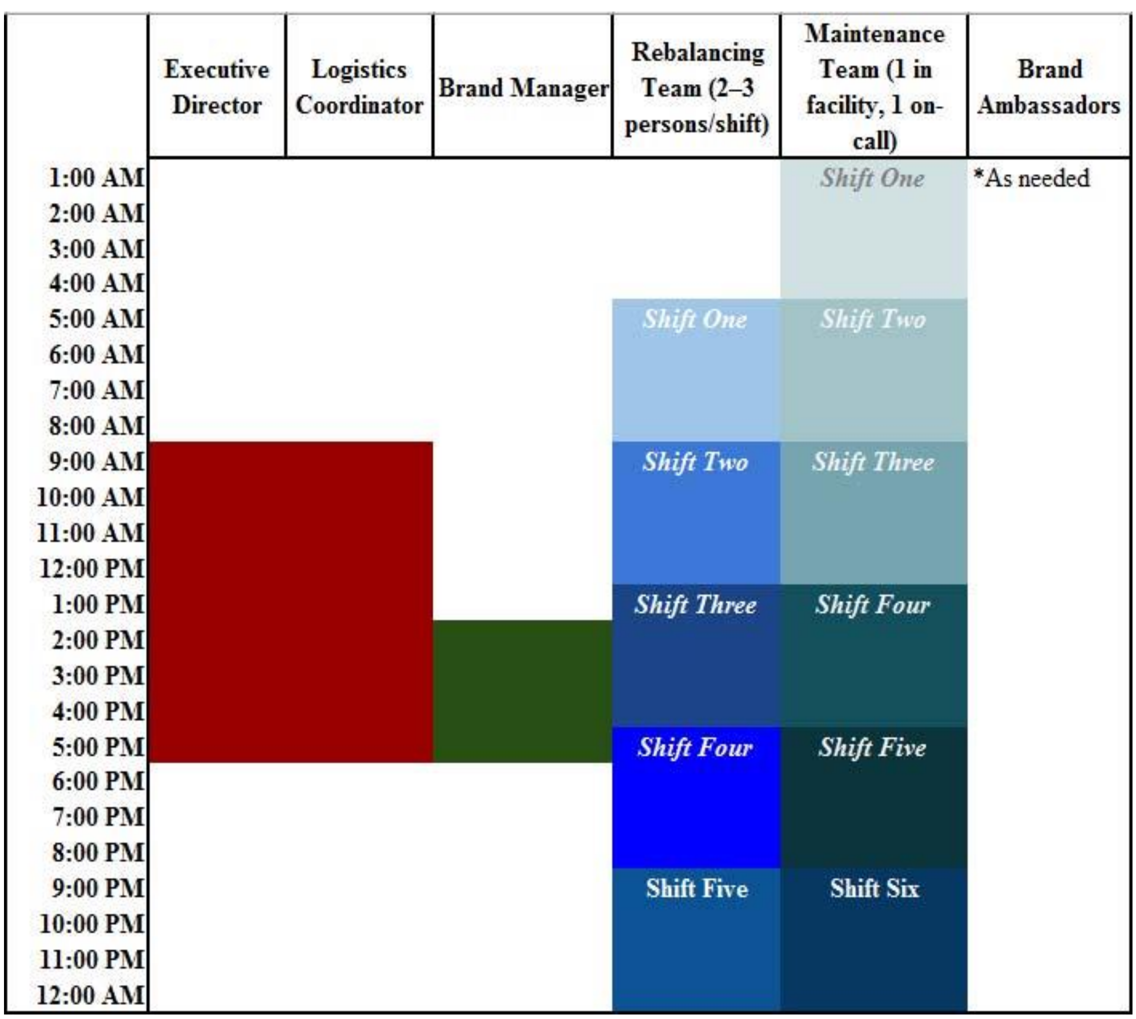
We developed a further mechanism in order to recover from a possible theft. We will use a device called *Boomerang GPS Device* [10]. It would cost 400 dollars and come with 4 years of service per device. We will place the device in a discreet location on each bike. Moreover, Boomerang will help the Operations coordinator to develop a rebalancing strategy. The Boomerang device will only track the location of the bikes, not the identities of the users, to avoid violating the users' privacy. As one can realize, it is a crucial part of our system.

3.6 Operational Procedures & Considerations

3.6.1 Staffing Model/Operating Hours

The Executive Director and Logistics Coordinator will work from 9am to 5pm, Monday through Friday, because they are traditional support jobs. Since the brand manager will be a Cornell student, they will only be allowed to work 20 hours per week, based on Cornell University regulations. There will be five rebalancing shifts, which each last for four hours. The rebalancing team will not work from 12am to 5am, because little to no demand is anticipated during these hours. Rebalancing teams arrive at 5am, in case any bikes need to be rebalanced before rush hour begins. Rebalancing continues in shifts until 12am, with two to three workers per shift (based on demand). Finally, maintenance will be available 24 hours per day. Maintenance staff are required to be available in case any users become stranded with a defective bicycle. There will be six maintenance shifts of four hours each. One worker will remain at the facility for any necessary on-site repairs, such as frame damage, whereas the other worker will be able to leave the shop when a call for maintenance is received. The first maintenance shift begins at 1am and ends at 5am. Shifts continue in increments until 1am, where the process repeats. Lastly, Brand Ambassadors will be hired as needed during the initial implementation of the system. This staffing model is depicted graphically in Figure 3.5.

Figure 3.5: Staffing Model



3.6.2 Customer Service Standard Operating Procedure

The operation of the team's proposed bikeshare system was modeled on a ticketing system that is similar to how many parking garages operate. The project team met and decided that developing a mobile application for a small bikeshare system would require a large capital investment and would also limit users that do not currently own smartphones. Furthermore, using a ticket system is a more robust method that does not depend on users having battery power available on their smartphones to rent and return bikes.

As discussed previously, the rental kiosks will only accept credit cards and debit cards to expedite the rental process. Not accepting cash at kiosks also eliminates the need for a worker to stock the kiosks with change throughout the day. However, a process has been established to allow cash users to rent bikes. The bikeshare system will partner with retailers, such as convenience stores and cafes frequented by students, to allow individuals to prepay for the rental in cash. The individual will be required to present a form of government photo identification, a phone number, and an email address. All of the renter's information will be entered in a secure database. The retail partner will then provide a prefabricated ticket to the renter that can be used to unlock a bike at a kiosk.

Before any rental, the kiosk will display a liability waiver that the user must accept to continue with the rental process. While the legal nuances are outside the scope of this report, the kiosk will inform users of the risks of riding a bike on uneven terrain and during poor weather conditions, such as thunderstorms or freezing conditions.

At the kiosk, A cash user will insert the ticket into the kiosk and accept the liability waiver. The kiosk will then display the bike number that is unlocked, display the return time on the kiosk screen, and print the return time on the ticket to remind the user.

A credit card or debit card user simply arrives at a rental kiosk and inserts his or her credit card or debit card, accepts the liability waiver, and pays for the rental. The user's credit card or debit card is used to track their rental progress, but is assigned a random value in the system. Only the payment processor will have access to the user's actual information, which will only be used if the user needs to be charged for any overages. The kiosk will display which bike has been unlocked and also display the return time on the screen.

For initial implementation purposes, the rental time has been fixed at one hour (60 minutes). When a cash user wishes to return a bike, he or she enters the ticket into the kiosk, docks the bike, and then receives a receipt printed on the ticket that serves as return confirmation. When a credit card or debit card user returns, he or she enters his or her card, returns the bike, and is then provided with a printed receipt. To account for potential discrepancies between the time displayed on the kiosk and a user's wristwatch, a grace period of 10 minutes has been established. If a user returns the bike after the grace period, then they will be charged at a rate of $4 per 15 minutes ($16 per hour), up to a maximum of the purchase price of the bike. The user will continue to be charged $4 for every 15 minutes the rental is late until the bike is returned. If the bike is never returned to a dock, then the user will have been charged the purchase price of the bike and will be allowed to keep it. A cash user will be contacted to pay any required fees using the information provided at the retail partner. If they refuse to pay, then their information can be referred to a collection agency. A credit card or debit card user is simply charged the owed amount using the information on file. However, the process for using collection agencies is outside the scope of this feasibility study. The process diagram for the system is depicted in Figure 7.

Figure 3.6: User Process

Figure 3.7 Collegetown in winter

3.6.3 Weather Constraints

Ithaca receives an average annual snowfall of 64.4 inches. Snow has been reported as early as October and as late as May [11]. Furthermore, Ithaca's steep and hilly terrain makes riding a bicycle challenging even without winter weather [12]. As such, snow presents a problem for any bikeshare system and may result in a user sliding on an ice patch or losing traction riding on a road that has not yet been plowed. Therefore, the team decided that the bikeshare system should not operate in the winter. While winter tires do exist for bicycles, it would still be risky for users to ride bikes during snowfall and expensive to change tires on every bike [13]. Furthermore, workers would need to be hired to clear all docking stations of snow, which would result in yet another additional cost. The City of Ithaca defines "winter" for snow plowing purposes as starting on November 1 and ending on April 1. However, Cornell's semester typically ends on an average date of December 15 and it would be illogical to stop operations when students are still attending courses. Therefore, the system would operate from April 1 to December 15 [14][15]. Obviously, any winter conditions that prevent normal operations during the aforementioned times would be posted to the company's website to let users know the bikes are not operational. In a worst-case scenario, the rebalancing teams can remove small quantities of snow from the docks if the weather permits operations.

3.6.4 Liability Waiver Information

Operating a bikeshare system may result in users injuring or potentially killing themselves. Thus, all bike renters will be required to accept a liability waiver before being able to ride. The legal aspects of the waiver are outside the scope of this report, but users will be waiving their right to sue, agree to hold harmless the company from any liability or medical bills that may occur riding our bikes, and understanding that while helmets are not provided, they are strongly suggested. Credit card and debit card users will be prompted to push an "I Accept" button on the kiosk, similar to when an individual accepts the terms and conditions when installing software. Cash users will be required to sign the liability waiver at the retail location where a rental is purchased. Cash users' signatures will be captured using a signature capture device on the point-of-sale terminal, so our company is able to verify that they have indeed signed the waiver. Finally, a waiver must be signed for each rental, to verify that customers are aware of the risks of using our bicycles.

3.7 Operational Standards

3.7.1 Standard Service Level Requirements [16]

The following standard service level requirements are envisioned for the bikesharing system:

1. Level of Operational Bicycles: Bike-to-dock ratio at least 50%.
2. Damaged Bicycles Removed from Service: 95% of damaged bicycles removed from service within twenty-four (24)-hour period after discovery by operator that a bicycle has been damaged.
3. Rebalancing: 95% of the time, stations are not full or empty in rush hour centers (these stations to be defined) or for more than 2 hours during rush hour (hours to be defined). No stations full or empty for more than 4 hours during hours of 6 a.m. to 10 p.m. If the system shows less than 1.5 uses per bike per day (or some other pre-defined metric), this service level is not enforced.
4. Station Availability: Stations available for public use at least 95% of operating hours.
5. Website Availability: Website available at least 99% of operating hours.

6. Preventative Bike Maintenance: Each station is visited every two weeks, and all bikes at that station are checked. Each bike is inspected at least once every two weeks.

3.7.2 Repositioning Procedure

Standard rebalancing levels have been mentioned in the service level requirements. We plan to employ two repositioning staff who should be including the driver of the repositioning vehicle as well as an assistant. The staff will be equipped with an Ipad with standard software which should be providing them the information from all the kiosks and stations as to the bikes. The primary task of repositioning staff would be to monitor the stations which have been under-filled or completely filled in order to provide for adequate repositioning of the bikes. The staff will be un-operational between the periods of 12 am to 5 am due to unavailability of enough demand for bikes. The optimization of time to rebalance stations would be an iterative process which shall be smoothening with time. Moreover, since we will use Boomerang, GPS hardware that allows its users to locate lost items, the Operations Manager will be able continuously keep track of the locations of the bikes which will help him develop a better rebalancing strategy.

3.7.3 Company Reporting Standards

3.7.3.1 Monthly Reporting – Operations [16]

Membership

The following membership data will be reported:

- Year-To-Date (YTD) counts at the end of the reporting month by type.
- Number of new sign-ups during the reporting month by day and month.
- Cancellations and refund requests of registered/existing members by type and period
- Expiration of registered members by type and reporting month.

Ridership

The following ridership data will be reported:

- Trips per day per station by member type and time.
- Total trips per month per station by member type.
- Breakdown of total trips per day of week and hour of the day by station.
- Average duration of trips by station, member type and time.
- Total length of trips by station, member type and time.
- Distribution of trip origin and destination by station.

Environmental Impact

The following environmental impact data will be reported:

- Estimation of calories burned per day/month by location, member type and time of trip.
- Carbon offset per day/ by location, member type and time of trip.
- Average Carbon offset per day/ by location, member type and time of trip based on “total members/total carbon offset”.

Rebalancing Operations

The following data on rebalancing operations will be reported:
- Data of number of bikes rebalanced per day.
- Data of number of bikes on the street based on their location and time.
- Data of instances of full/empty stations, start time and end times of journeys
- Breakdown of full/empty instances by duration.
- Percentage of time stations are optimal, full, or empty.
- Breakdown of rebalancing time when stations were full/empty.

Station Maintenance Operations

The following data on station maintenance operations will be reported:
- Number of active stations.
- Number of station visits by maintenance staff for normal maintenance.
- Data of all station malfunctions (station, start/end date/time, event).
- List of all dock malfunctions (station, start/end date/time, event).
- Percentage of time stations were available to provide rentals for all membership types by station and system wide.

Bicycle Maintenance Operations

The following data on bicycle maintenance operations will be reported:
- Count of bikes checked per day/month.
- Count of bikes repaired per day/month.
- Data of average time per repair.
- Full list of repair types (minor, major, annual maintenance or overhaul).
- Breakdown of the cause of repair needs (normal wear, crash, warranty failure, vandalism).

Incident Reporting

The following data on operational incidents will be reported:
- Data of all incidents (crash, vandalism, theft, police action) with dates and summary of outcomes.
- Stolen/missing bike list and status.

Customer Outreach

The following data on customer operations will be reported:
- Web page analytics.
- FB/twitter posts count and summary.
- Gift Certificate sales summary.
- Corporate membership sales summary.

Quarterly Reporting

The following data will be reported in quarterly reports:

- Demographics of registered members (age, gender, zip code).
- Maps showing population density ratio.
- Maps showing station usage report
- Revenue generated per station (casual member purchases and trip fees incurred by trips starting at the station).

Weekly Reporting

The following data will be reported in weekly reports:

- Trips per day per area for the previous week.
- Types of New members from the previous week.
- Bikes on the street per day for previous week.
- Total revenue generated from trips that lasted for more than 30 minutes for the previous week.

Other Reporting

Other reporting could include user surveys, demographics, usage statistics, transit trips and user preferences data.

3.7.3.2 Maintenance

General Maintenance standards [16][17]

The following general maintenance standards will be observed:

- Tire Pressure for recommended standards and signs of damage
- Tightness of handlebars, headset bearings and full handlebar range of motion.
- Front and rear brake function including lever tightness and damage
- Grips wear and tear
- Bell tightness and function
- Handlebar cover
- Gear functionality (if any)
- Front and rear fenders for damage
- Front and rear wheels – trueness, spokes and hub/axle tightness
- Front and rear LED lights
- Reflectors on wheels, seat and basket are present, clean & undamaged
- Pedals and cranks tightness
- Chain and tensioner function and lubrication
- Kickstand function
- Overall functionality of bike
- Aesthetics, sponsor stickers and company logos for cleanliness and visibility

Annual preventative maintenance

Annual preventative maintenance includes the following:

- Removal, cleanup and adjustment of the entire drive-train, including brakes and gear systems.
- Inspection and adjustment of wheels
- Inspection and replacement of tires with excessive wear, defects
- Inspection of hubs to make sure they are functioning properly.

3.7.4 Maintenance Procedures

Standard maintenance procedures are explained in the service levels requirement. We plan to employ two different types of maintenance staff -On-street and off-street. The off street maintenance staff will be primarily located in the warehouse where they will be looking after the overhaul and repair of bikes that have been damaged significantly. The on-street maintenance staff will be contracted to visit incidents on a need-to-need basis. The procedures should include simple steps such as receiving primary information such as location and type of the incident. This would allow them to make sure whether the case can be solely handled by themselves or not. For example, Scenarios where ambulance services are required for injured cyclists are not the responsibility of Big Red Shares. Thus, maintenance staff is required to visit the sites in the order of the priority set by the operations manager.

3.7.5 Compliance & Safety

3.7.5.1 Sample Insurance Coverage

Prior to the Effective Date, Big Red Shares shall deliver to the Purchasing Agent a Certificate(s) of Insurance, attached hereto as Exhibit A , indicating that Big Red Shares has in force the insurance coverages described below [18]. Big Red Shares agrees to maintain such insurance coverages until the completion of all of Big Red Shares obligations pursuant to this Agreement, including without limitation, all warranty periods. As such, all liability insurance coverages shall be written on an occurrence basis. All required insurance coverages shall be acquired from insurers qualified to do business in the County of Tompkins and acceptable to the City of Ithaca. The minimum insurance coverages shall be:

A. **Worker's Compensation**, with Employer's Liability limits of not less than the greater of: (i) one million dollars ($1,000,000) for each accident or (ii) the statutory limit for each accident.

B. **Commercial General Liability**, including all coverages contained in an un-amended I.S.O. Form CG 00 01 with limits not less than one million ($1,000,000) dollars for each occurrence and three million ($3,000,000) taken together for each annual policy period of Combined Single Limit Bodily Injury and Property Damage. Such form includes Contractual Liability, Personal Injury, Advertising Liability, Broad Form Property Damage, Products and Completed Operations coverages.

C. **Comprehensive Automobile Liability Insurance**, with limits not less than one million ($1,000,000) dollars each occurrence Combined Single Limit Bodily Injury and Property Damage, including owned, non-owned and hired auto coverages, as applicable.

D. **Excess Liability Coverage**, following the insurance referred to in clauses A, B, and C above in the amount of three million ($3,000,000) dollars per occurrence, Combined Single Limit, and three million ($3,000,000) dollars in the aggregate for each annual policy period.

Endorsements and Sponsorships -Commercial General Liability and Comprehensive Automobile Liability Insurance policies shall be endorsed to provide the following:

E. To name as additional insureds, with respect to the operations of Big Red Shares under this Agreement, the City of Ithaca, and all of its elected and appointed officials, officers, employees, agents, departments, agencies, boards, and commissions, and those sponsors who own property on which Rental Site(s) that are a part of the System are located; and

F. To provide that such policies are primary insurance to any other insurance available to the additional insureds, with respect to any claims arising out of this Agreement, and that insurance applies separately to each insured against whom claim is made or suit is brought.

Notice -All policies shall be endorsed to provide that there will be thirty (30) days advance written notice to the City of cancellation, nonrenewal or reduction in coverage.

3.7.6. Rider Safety

3.7.6.1 *Road Rules* [19]

Big Red Shares shall be responsible for putting up resources and highlights to safety standards for drivers and pedestrians along with laws for crosswalks, entering the street, sharing the road with bicyclists on its website and stations. Some of the required safety laws are as follows [5]:

3.7.6.2 Laws for Drivers

Crosswalks

Section 1151, NYS Vehicle & Traffic Law ·

Section 1172, NYS Vehicle & Traffic Law

Entering the Street

Section 1173, NYS Vehicle & Traffic Law · Section 1151-a, NYS Vehicle & Traffic Law

Sharing the roads with bicyclists

Section 1234, NYS Vehicle & Traffic Law ·

Section 1122-a, NYS Vehicle & Traffic Law

Safety

Section 1146, NYS Vehicle & Traffic Law

3.7.6.2 Laws for Bicyclists Riding on the road

Section 1231, NYS Vehicle & Traffic Law

Section 1230 (a), NYS Vehicle & Traffic Law

Bicycling with others

Section 1234 (b), NYS Vehicle & Traffic Law

Where to ride

Section 1234 (a), NYS Vehicle & Traffic Law

Turning

Section 1234 (a), NYS Vehicle & Traffic Law

Section 1237, NYS Vehicle & Traffic Law

Equipment

Section 1236, NYS Vehicle & Traffic Law

Safety

Section 1235, NYS Vehicle & Traffic Law

Section 375 (24-a), NYS Vehicle & Traffic Law

Helmets

Section 1238(5), NYS Vehicle & Traffic Law

3.7.7. Helmets

New York State's helmet law:

In New York State, as of 1989, children between the ages of one and five years must wear an approved bicycle helmet and be seated in a seat attached to the bicycle when riding as a passenger. Effective June 1, 1994, all persons between the ages of one and 13 will be required to wear a safety helmet while on a bicycle. It is highly recommended, however, that all bicyclists wear helmets. Seventy-five percent of all bicycle fatalities and serious injuries involve brain damage that could have been prevented or lessened in severity if a helmet had been worn (§1238).

Children under one year of age may not be carried on a bicycle.

Figure 3.8: NY State Law on Helmet Safety

Tompkins County suggests that every bicyclist should wear an approved helmet to reduce risks of serious head injuries. Helmets should be of standard size to cover the top of head in a level position to an inch above the eyebrows and they should not slide back and forth on the head or rock from side to side [20][21].

The company will not provide helmets to bike users for the use in the town of Ithaca which should be mentioned in the company website as well as stations. Tompkins County has strict laws for the use of helmets for everyone under the age of 14. Also, no users shall ride their bikes with children under the age of one which is prohibited by the laws. Users of all ages shall be encouraged to bring their own helmets. Helmet requirements and education can be found on safety websites [7].

Big Red Shares shall not be implementing the use of helmets for the following reasons:

- Difficulty to implement helmet storage systems for individual users
- Handling of additional inventory leading to higher operational costs
- Requirement of additional staffing to maintain helmets manually
- Unavailability of state and county laws to provide helmet in bikesharing domain.

3.7.8. Assumption of Additional Risks

Big Red Shares assumes all risks for direct and indirect damage or injury to the property or persons used or employed in connection with the work contracted under the insurance policy.

In case of damage or injury to any person or property wherever located, resulting from any negligent action, omission, commission or operation under this Agreement, or in connection in any way whatsoever with the contracted Work shall be dealt with through insurance policies and federal laws for safety by citizens. Some of these are include:

- Negligent homicide
- Reckless riding
- Use of drugs/alcohol
- Hit and run-unattended
- Violation of road rules

No acceptance or approval of any insurance by the City shall be construed as relieving or excusing Big Red Shares from any liability or obligation imposed upon Big Red Shares by the provisions of the Contract Documents.

Big Red Shares shall be responsible for the Work performed under the Contract Documents and every part thereof, and for all materials, tools, equipment, appliances, and property of any description used in connection with the Work.

Big Red Shares shall be as fully responsible to the City for the acts and omissions of its subcontractors and of persons employed by the subcontractors as Big Red Shares is for acts and omissions of persons directly employed.

3.8 Quantitative Operational model

We have developed a model to describe the expected behavior between users, bikes, and the repositioning truck using a variable time-step discrete event analysis. We model users entering and exiting system, taking out bikes, and when there are either too many bikes or too little bikes at any particular dock, sending a truck to redistribute.

This code determines the demand (where person wants to take a bike from and where they would like to go and when) entering into the system to have similar distribution both temporally and spatially to what we would expect. We have a basis for what we expect to happen in reality because of our survey data. We could also use TCAT data, and weight downhill activity more heavily depending on the quantification of "willingness to go uphill" from our survey as well.

We have implemented two versions of this model, one using python and a simulation library, object oriented programming, and multithreading. Another model is coded in traditional discrete event analysis in Matlab. Both versions, and proto-code for each are included in the appendix of the document. While the proto-code is different for each implementation, the final program behavior is comparable.

In addition to describing the behavior of people in the model, which is relatively simple (if one has a bike to take, they take it, and randomly choose one wants to go using the aforementioned proportions), the behavior of the truck is nontrivial. When actually deciding when bikes should when we actually implement the bikeshare program, we should be using historical data we collect and a forecasting model to optimize the truck use, but for the purposes of estimating the cost, we have drawn up a tested, fairly robust algorithm that attempts to make sure each dock has at least one empty slot and one available bike. The algorithm for truck behavior is as follows:

- If there any docks that are filled to a certain threshold, we rebalance from nearby docks to offset it, choosing from the dock that is both nearest and capable of providing enough bikes.
- Then we look to see if there are any docks that are too empty (we prioritize too full docks because the effect to the customer is higher in that case)

The model is coded so that parameters are defined as variables, allowing us to change parameters to change aspects of the model being tested. E.g. the number of bikes at each bike stop. Here are several parameters that we can modulate to look for different solutions:

- Number of bikes per station
- The total number of bikes that can dock at any station
- The starting distribution per dock per day
- Quantitative thresholds that govern the behavior of the rebalancing truck

In addition to these parameters, which are quantitative and relatively continuous, we can make changes to the behavior of the truck, including the thresholds that govern its actions. We can also modulate the number of docks that are being used in the model.

Here are some parameters that come from assumptions, comparable bikeshare systems and the market survey data that could be examined in a sensitivity analysis.

- The likelihood that any person who enters the system is coming to which dock and wants to go to which dock
- The time it takes to travel between docks (currently done using google map's estimates)
- The total number of people who want to use our system a day
- The capacity of the truck
- The speed of the truck

The model monitors how many users that request a bike but cannot get one because there aren't any bikes left, and the % of time bikes are used --this is called the "utility" of the system.it Also makes an estimate of the relative price of the model being run at any set of parameters by taking into account # of bikes, # of bike rides, minutes of bike ride, etc. As an end result, we have a "black box" with three output variables (two utility functions and cost), for any valid set of parameters. We use this to make a data-drive search in parameters space, with estimates from comparable as a starting point. In effect, we are attempting to find Pareto efficient and/or weak Pareto efficient tradeoffs between our parameters. We are completing parameters sweeps to determine local maximum.

3.8.1 Consideration of Alternatives:

There are inherent weaknesses of basing our demand data on TCAT: that data will be biased in that it will only represent demand that adheres to established bus routes (it doesn't give us perfect to-and-fro data), and doesn't include preference for going uphill/downhill. Using purely TCAT data results in the subsequent simulation's output being almost entirely meaningless.

In general, we are careful not to just blindly use data without considering the context of the problem. For example, we choose to do on demand rebalancing because we expect that there will be strong shifts in user behavior depending on the time of day--not doing so would mean that we could only service the number of users per cycle equal to (approximately) the capacity of the docks. Of course, one could increase the amount of bikes at a dock, or increase the number of docks, but this just results in a poorly optimized, inefficient system.

3.8.2 Further work required:

There is significant functionality of our model that is in progress that may not be able to be completed but are being explored at the time of writing of this report:

• More systematic search/optimization of "black box." Current method is user initiated.
• Creating a relation between pricing and consumer behavior--and then using this in the operations model and the financial model to optimize the pricing. For example, from our model we know what proportion of people are willing to pay for certain levels of pricing --we scale our daily demand by that proportion, and the connect the outputs of our operations model to our financial model
• Monte Carlo sensitivity analysis on parameters once arriving at the Pareto optimized parameter set using reasonable priors accounting for error (e.g. the array describing demand)

3.9 Comparison to Zagster

BIKE-SHARE COMPARISON WITH EXISTING SYSTEM		
Metrics	**Big Red Share**	**Zagster**
Number of Stations	8	5
Number of Bikes	56	32
Membership Options	Daily Pass – $8 Monthly – $20 Annually -$50	Pay as you ride – $3/hour Monthly – $ 15 Annually -$ 30 (Cornell) , $ 60 (others)
Station Locations	• Dairy Bar • Appel • Thurston • RPCC • Noyes • Stewart & University • Sage Hall • Engineering Quad • Bailey Hall • Arts Quad Libraries • Ives Hall • Dairy Bar • Vet School • Teagle Hall • Commons • Greenstar (Buffalo) • Greenstar Collegetown • Court St & Cass Trail	· Balch Hall · Stimson Hall · Kennedy Hall · Stocking Hall · Schoellkopf Hall
Competitive Advantage	Ithaca’s in-house bikeshare system backed by Tompkins County and Cornell University	Private Company renowned for existing bikeshare systems in various other locations

Figure 3.9: Comparison Table to Zagster Bikeshare

3.10 Future Considerations

Figure 3.10: Electric Bike

3.10.1 Electric Bikes

As an alternative, we considered using e-bikes, which is a bike with an integrated electric motor. Technically, it is a great option to use in Ithaca since the city is extremely hilly. There are different types of e-bikes. We thought the one with small motor to assist the rider's pedal power would be the best option in our case. Riders can use the motor while going upwards and pedals otherwise. We think it would increase our customer base since it would eliminate the discouragement people have because of the hills. However, we concluded that the cost of implementing the system exceeds the benefits. As a result, we may only implement it if we have enough subscriber density in the future.

Figure 3.11: Sample App Based System [22]

3.10.2. App-based system

The team had a chance to review alternative operational models for bikeshare system. Though, beyond the scope of this project, an alternative approach could have been the implementation of an app-based system which would allow users to rent bikes using their smart phones. Though, many of these systems are cheap there are certain implications associated with them. For example, they require access to smart phones by all the potential customers. On segmenting the target customers for this project, it was decided to target customers of all types, irrespective of their ownership of smart-phones and internet connections. This would allow flexibility for incoming tourists as well as reduce the hassles of IT support as a core component of the operations team.

4. Finance

We used an income statement to represent our financial model. An income statement will give us our net profit or loss which we will use to discover the profitability of the system. The revenues and expenses are thoroughly explained in the following sections. In regards to ownership, we chose to design the system as a for-profit business model in which a private company has the responsibility to provide funds, operate the whole system and lastly take on risks and profits. The main function of this section is to supply values to represent the profitability of a bikeshare system both when implemented and for years after.

4.1 Assumptions

In order to create our financial model, we had to make many assumptions. These assumptions are based off of comparable from the case studies we have reviewed. All assumptions are discussed and explained in their respective parts as they contributed to specific calculations.

4.2 Revenue

4.2.1 User generated revenue

Our calculated revenues are generated primarily from user revenues. These revenues are in two parts: revenue from membership and revenues from late return fees.

Revenue from membership

For membership revenue we predicted how many users would sign up for each membership plan. We assumed that 20% of our riders would sign up for annual membership, which costs $50 per unit; 22% of our riders would sign up for monthly membership, which costs $20 per unit; and 58% of our riders would sign up for a full-day ride with an $8 payment. This assumption is based on the result of our marketing survey, which indicates that for people who are interested in using Bike share in the sample, 22% are willing to pay for an annual plan, 17% are willing to pay for a monthly plan, 10% are willing to pay for daily use, and 48% are willing to pay per ride. After considering the situations in actual operation, we choose to operate the bike share program in 3 modes: annually, monthly and daily. As for the cost of each type of membership, we came up with a range to help decide the final price strategy. We looked through pricing schemes of other university’s bike share programs as well. In our financial model, for annual and monthly members, no more fees are required within a riding period of 60 minutes. For late return fees, since we cannot get the data from the survey, we referred to case studies in different cities and came up with the assumption of 33% users would return the bikes late and cause a $4 late returning fee.

Table 4.1 Case studies of other universities

University	Annual Membership	Monthly Membership	Daily ride	Late return fees
University of Buffalo (with a register fee of $15 and students can have 20% off all prices)	$55, having a lower rate of 1cent per hour	Activation fee: $8; having a higher hourly rate of 6 cents per hour; valid for a month	-But with a group rental strategy	-
University of Virginia ($3 per hour)	$80 with a daily free time of 90 minutes (for students and staff: $60)	$15 with a daily free time of 90 minutes	Overage fees: $1/hour	$5 for locking out of hub; $50 for locking out of system
Purdue University (trips under 2 hours are free with membership)	$35	-	$5 24-hour membership; $2 per hour, up to $10 per ride	$30 overnight charge for keeping a bike over 24 hours
Ohio State University	$35 for students and $55 for staff and $75 for public	-	$6 per day	-
Yale University	$45	$10	$5	With membership, trips under 2 hours are free; after the first 2 hours, rides are $3/hour

Our marketing survey contained two main questions inquiring willingness to pay from residents. The first, "what kind of subscription would you prefer for a bike share" and second, "up to how much will you be willing to pay for your plan." The results gave us an average price of $48.28 for an annual membership, $22.26 for a monthly membership, and $8.04 for a day pass. These results, accompanied by the insight gained from looking at other systems, gave us the price structure we chose.

To generate a further sensitivity analysis in the following sections, we discussed the range of the proper price combining real life situations, such as people would not choose to pay for the bike share program for more than $70.

Table 4.2 Ranges for membership prices

Revenues	Lowest price	Proper price	Highest price
Revenue from annual membership	30		70
Revenue from monthly membership	10		25
Revenue from full-day membership	5		15
Revenue from late return fees	3		7

Besides, we assume that annual members would use other service such as monthly ride or daily ride occasionally. In these cases, we assume that monthly riders sign up for 1.5 monthly-memberships per year on average, and full day riders sign up for 2.5 full-day passes per year on average. Thus, we calculate the monthly and daily user revenue with respective multiplier of 1.5 and 2.5, comparing to the user revenue of annual user revenue. From monthly customers, we assume that forty percent of monthly riders will also be daily riders, averaging once per year.

Revenue from late return fees

We assumed that one third of our customers would return bikes late and thus generate late return fees. We set the late return fee as $4. Both the fee value and estimate of amount of users is based off of comparable information.

4.2.2 Opportunities for additional revenue

Our current revenue is all generated by users. In order to provide better customer experience when using our bike share system, more funding could be used to update our system. Below are some ways of generating more revenues that are common among bikeshare systems.

i. Advertising

Advertising uses regularly changed graphs or short slogans and messages to help promote the company we have the contract with. These advertisements could appear on bikes or stations.

ii. Sponsorship

Sponsorship is a slightly different method to generate revenue mainly because sponsorship requires a longer and deeper involvement with the sponsor company and the company have the naming right. Thus, sponsorship provides more funding. There have been many cases of sponsorships for bikeshare systems in other cities across the country. Following are some primary examples

- Citi Bikes – sponsorship fee in February, 2017 of $2,429,455, and for the period of February YTD, the sponsorship funding is $5,517,789.
- Denver B-cycle – sponsorship funding of $524,581 during the year of 2016.
- Hubway – multiple sponsors and partners including New Balance corporate and having Barr Foundation as a donor.

4.3 Expenses

A bikeshare system encounters many expenses that we included in the financial model. Each expense is explained below:

i. Bike and station expense

Our operations design consists of 56 bikes and 8 designed docks. The cost of each bike is $350 and the cost of stations (Dock and Kiosk) plus installation are $4200 per unit. Additionally, there is an anti-theft expense for bikes of $200 per bike.

ii. Regular maintenance expense

Regular maintenance expense is a large portion of the expenditure. The maintenance fee is $1600 for one bike. This expense also includes the salary of staff for maintaining and rebalancing the system.

iii. Employee salary expense

Employees are needed to manage and maintain operations. The detailed costs are shown in the operational cost table.

iv. Facilities expense
Facilities include operating essentials such as website design and carrier chargers. Details are shown in the operational cost table.

v. Marketing expense
As a general assumption, we set the marketing expense as 2.5% of revenue. This value encompasses all the expenses of marketing our system to the local system. Clearly, as our system grows we would increase marketing, which is why we set the expense as a percentage of a value correlated with growth.

vi. Compliance expense
The compliance expense is mainly insurance fee and it is $275 per unit.

vii. Utilities expense
Utility expense include electricity and miscellaneous utilities.

4.3.1 Ways to manage expense

As we can see, the largest expenses are the employment salaries and regular maintenance fee. However, it is essential to consider the budget issue with a long-run point of view. These values are likely to lessen overtime as managers of the system gain experience and technique. Our model predict the expenses as accurately as possible given our assumptions, but below are some thoughts that could help manage expenses.

- With the number of bikes required increasing year by year, we could ask for a discount for the bike and station expense. This situation also suits for facility costs.
- We could train employees to work more efficiently. We further could pitch the opportunity as a learning experience or resume builder. This would allow us to hire students for a lower amount. Lastly, we could find volunteers to help manage the operation.
- We also could save marketing expense by promoting our bike share program by introducing it to freshmen through clubs or word of mouth, which is both efficient and cost-effective.

4.4 Depreciation

Depreciation is an accounting method of allocating the cost of tangible assets over their useful life, such that expenses are matched with revenues. We depreciated our long-term assets (bikes and stations) for both tax and accounting purposes using the straight line method of depreciation. In straight line depreciation method, cost of a fixed asset is reduced uniformly over the useful life of the asset.

Depreciation Expense = (Depreciable Amount) / (Useful Life)

The way we applied the straight line method of depreciation is described below for each case.

4.4.1 Bikes

The purchase and installation cost per bike was estimated to be $350, hence our depreciable amount was equal to $350. After considerable research on successful bike-sharing programs we determined that the average useful life of bikes will be seven years with zero salvage value. That means that after year seven we have to start buying bikes so that we can replace the ones that will be fully depreciated. For example, the bikes bought in year 8 will replace the bikes bought in year 1, bikes bought in year 9 will replace the bikes bought in year 2 etc. The depreciation expense per bike per year is $500/7 = $71.43. In order to calculate the total depreciation expense per year, we added the expenses to buy new bikes for the previous years (up to 7 years back) and then divided the result by 7. The following are the calculations.

Depreciation expense (year 1) = [Bike expense (year 1)]/7
Depreciation expense (year 2) = [Bike expense (year 1)+Bike expense (year 2)]/7
…
Depreciation expense (year 7) = [Bike expense (year 1)+...+Bike expense (year 7)]/7
Depreciation expense (year 8) = [Bike expense (year 2)+...+Bike expense (year 8)]/7
…
Depreciation expense (year 13) = [Bike expense (year 7)+...+Bike expense (year 13)]/7
Depreciation expense (year 14) = [Bike expense (year 8)+...+Bike expense (year 14)]/7

4.4.2 Stations

Each station (dock and kiosk) cost was estimated to be $4200. Conducting research on the average useful life of the stations, we determined that the stations could last for 14 years with zero salvage value after the end of the 14th year. Since our model includes the first 14 years of the bike-sharing project, we will not have to replace any docks during the first 14 years of the project. The depreciation expense per station per year is $4200/14= $300. In order to calculate the total station depreciation expense per year, we followed a method similar to the one used for calculating the total bike depreciation expense per year. More specifically, we used the following formulas:

Depreciation expense (year 1) = [Station expense (year 1)]/14
Depreciation expense (year 2) = [Station expense (year 1) + Station expense (year 2)]/14
…
Depreciation expense (year 13)=[Station expense(year 1)+...+Station expense(year 13)]/14
Depreciation expense (year 14)=[Station expense(year 1)+...+Station expense(year 14)]/14

Although depreciation was calculated in this way, this was not reflected in the expenses section of the Financial Model. Rather, the bicycle expenses were incurred in the year purchase since "the purpose of recording depreciation as an expense over a period is to spread the initial purchase price of the fixed asset over its useful life." (https://www.thebalance.com/depreciation-and-amortization-on-the-incomestatement-357570) However, it was decided that the former method of incurring this expense would be used for purposes of the financial model since there are minimal tax advantages for Bikeshare if the latter method was used.

4.5 Financial Analysis

4.5.1 Revenue Projections

In order to calculate the revenue for the future (years 2-14), we made the same assumption we used for calculating the first year's revenue. More specifically, we assumed that if we have one bike per 100 users, then providing x number of bikes will give us a total number of users equal to 100*x.   After that, we found the revenue from each type of subscription (daily, monthly, yearly) by multiplying the proportion of users (58%, 22% and 20% respectively) with the total number of users and the price of each subscription type ($8, 20$ and $50 respectively). We also had to account for the inflation. The average yearly inflation rate in the US is 3.22%, so we multiplied the result by (1.0322)^(year) , depending on the year to which we refer. Our calculations give the following results.

Table 4.4 Revenue Projections

Year	Revenue ($)
1st	175,243
2nd	180,885
3rd	373,420
4th	481,805
5th	596,783
6th	718,666
7th	847,780
8th	875,078
9th	903,256
10th	932,340
11th	962,362
12th	993,350
13th	1,025,336
14th	1,058,352

4.5.2 Expense Projections

The future expenses (years 2-14) were calculated using the same formulas that were used for the first year, but this time we had to multiply by the inflation factor, in order to take the inflation rate into account. The average yearly inflation rate in the US is 3.22%, so we multiplied the result by (1.0322)^(year), depending on the year to which we refer. Our calculations gave us the following results:

Table 4.5 Expense Projections

Year	Expenses ($)
1st	359,221
2nd	272,110
3rd	457,754
4th	513,294
5th	563,991
6th	669,912
7th	727,887
8th	763,559
9th	759,498
10th	824,920
11th	830,340
12th	865,013
13th	876,484
14th	921,617

4.5.3 Net Profit (Loss) Projections

The Net Profit (Loss) was calculated by subtracting the yearly expenses from the corresponding revenues and then taking into account the tax expense. Using the expenses and revenues calculated as shown above, we have that:

Table 4.6 Net Profit (Loss) Projections

Year	Net Profit (Loss) ($)
1st	(183,978)
2nd	(91,224)
3rd	(84,334)
4th	(31,489)
5th	21,315
6th	31,690
7th	77,930
8th	72,487
9th	93,442
10th	69,823
11th	85,814
12th	83,419
13th	96,754
14th	88,878

4.6 Net Present Value and Breakeven

The Net Present Value (NPV) and breakeven year were two values computed in order to determine the financial feasibility of this project. The Net Present Value for the Bikeshare project essentially represents the project's intrinsic value. In other words, this is value that the Bikeshare project holds over its assumed life-cycle of fourteen years. As a rule of thumb, if the NPV is greater than 0 then it is a worthy project to invest in. However, if less than 0 then it is not worth pursuing. When calculating the NPV of the Bikeshare project, the following formula was utilized:

Here, C(0) represents the initial investment, which has been assumed to be equal to zero for purposes of valuing the project. C(t) refers to the net profit (loss) generated each year. The range of "t" is from Year 1 to Year 14. Lastly, "r" represents the discount rate, which is the investor's required return on the project. This value was assumed to be equal to inflation each year, which is equal to 3.22%. Although this is a risky project, which may result in investor's requiring a higher return, the assumption that allowed for this discount rate was that rather than investors, there will be sponsors; and those sponsoring the project will not ask for a required return, therefore making the discount rate solely a function of inflation, not risk.

When completing the NPV calculation, it was found that the Bikeshare project has a Net Present Value of $159,573, making this project feasible to implement. Additionally, this means that the breakeven point will occur sometime within the lifecycle of the project. By definition, the breakeven year is the year in which the positive cash flows finally exceed the positive cash flows after adjusting for the discount factor, which is assumed to be inflation here. Doing this analysis, it was found that the breakeven year will occur in Year 12.

The last aspect utilizing the NPV calculation was to determine the sponsorship required in order to get the project started. In order to determine this value, each of the Net Losses were obtained and discounted back to the present. For this Bikeshare project there was a Net Loss for Years 1, 2, 3, and 4. Therefore, these were the losses discounted and then summed together. After doing so, it was found that the total sponsorship required is $380,145. In other words, this is the same as if a sponsor were to donate an annuity (yearly donation) of $36,250 for the entirety of the Bikeshare life-cycle.

4.7 Financial Risk

There is much financial risk that accompanies bikeshare systems. This is evident by noticing that each bikeshare system that is implemented has a company or institution backing it financially. The financial risk of our system mainly comes from two parts. The first part is the general risk for bike share programs. The second is the assumptions we made as described in the beginning of the financial model design.

4.7.1 General Bikeshare program risks

The general risk for bike share programs is a serious problem for all bike share service providers and designers. Nearly all the current bike share programs fail to break even in the beginning. It is difficult for bike share programs to economically sustain revenues from daily operation alone. The designing of the system, purchase of bikes and docks, hiring of staff and marketing costs requires sufficient capital support. Thus, the operators of a bike share program need to find sustainable ways to obtain outside funding. As federal support may not be possible for most of the bike share programs, operators need to find other capital sources such as private donations and sponsorships. Most of the bike share projects in North America, Europe and Asia lost money at first and were unlikely to succeed in the beginning. The ones who survived made adjustments to their financial model, pricing strategy or marketing strategy to acquire more customers and more funding. However, getting outside money may bring in more regulations on how the bike share program should operate. The initial team operating the bike share program may suffer to meet these regulations and to give back the expected returns agreed with the outside investors.

i. Accident compensation

Compensation for safety issues may become another major unexpected cost for the bike share program operators. There has been solid evidence shown by researchers that bikeshare riders are much safer than private riders due to superiorly designed bikes and regular maintenance by professional workers. However, the low accident rate could not eliminate the compensation cost. If the accidents could be proved to be caused by improper design of the bikes or the lack of maintenance, the bike share program needs to be responsible for the compensation fee that may occur.

ii. Competition

Even though bike share programs are burgeoning all over the world, the competition is becoming more and more tenses. Competition from other bike share providers with similar capital support would be fatal to a bike share program. The price wars in major Chinese cities may be a good example. Price wars lasting for months and years would eat up the possible profit and make breaking even much harder. Competition from other shared travel modes may also impede the development of bikeshare programs. Uber and Lyft have conquered nearly all the major cities in the US and are still expanding. In extreme weather, a large proportion of bikeshare users would choose to take a car-share system instead.

4.7.2. Risk Assumptions

During the initial design of a bikeshare program in the Cornell and Ithaca area, some assumptions were made. These assumptions are necessary for building the model and evaluating the financial prospect of the bike share program. However, these assumptions may bring some extra risk for the result of the financial model.

i. Inflation rate
The inflation rate of 3.22% per year was used to account for the depreciation of the capital in the model. The number comes from the average inflation rate in the US in recent years and may change slighted in the following years the model covered.

ii. Revenue from late fees
In the model, the designers assume that one-third of users would return their bikes late and pay the late return fee. This was based on the average number from other operating bike share programs. This becomes a considerable proportion of total revenue. However, this proportion is based on many conditions. Users of Cornell bike share program are mainly students and residents of Ithaca. As the proportion of well-educated users is higher, the late return rate may be lower. Ultimately, the exact late return rate can only be determined after operations begin.

iii. Membership percentages
The proportion of annual, monthly and full day riders came from investigations of students through the market survey. However, there would be overlaps between different kinds of users. For example, a monthly user may become a full day user in a month without monthly membership. How many monthly memberships and full day memberships would a typical monthly user and full day user purchase one year? The current assumption of the financial model is that on average 40% of monthly riders will also be daily riders, averaging once per year. Secondly, monthly riders sign up for 1.5 monthly-memberships per year. Lastly, full day users are assumed to purchase 2.5 full-day passes per year. The figures are a conservative estimation of the real situation as monthly users may be students who enjoy riding bikes to commute but want to purchase monthly and daily memberships to save money. Thus, a typical monthly member may purchase daily membership more often than once a year. After operation of the bike share program, adjustments would be made to the financial model for precision.

4.7.2 Sensitivity Analysis

The aim of a Sensitivity Analysis is to project and predict the best and worst possible revenue cases upon project implementation. All the expenses in the financial model have been assumed to remain constant during this time.

The range of values, including Low, Actual, and High, are shown in the table above. They were calculated using the market survey data procured. They are taken as +/-0.5 standard deviations away from mean of each of the Actual values. [Note: The standard deviation considered here is a 'nominal standard deviation.' That is, it was calculated from the 'real standard deviation' (which considered all values we had from the market survey data). All data-points lying outside +/-1 standard deviations of 'real standard deviation' were considered as outliers and neglected while calculating 'nominal standard deviation'.]. However, the ranges for 'Late Return Fees' have been assumed to be as low and high as $3.50 and $5.50 respectively.

Revenue	Low	Actual	High	Sources of Range
Revenue from Annual Membership	$40.82	$50	$59.19	Nominal +/- 0.5 Std dev = $9.185
Revenue from Monthly Membership	$14.76	$20	$25.25	Nominal +/- 0.5 Std dev = $5.245
Revenue from Full-Day Riders	$5.25	$8	$10.76	Nominal +/- 0.5 Std dev = $2.755
Revenue from Late Return Fees	$3.50	$4	$5.50	Based upon assumption
Best Case (Highest possible Revenue)			NPV =	$1,648,786
Worst Case (Lowest possible Revenue)			NPV =	-$1,647,989

The results of the sensitivity analysis are a Best Case (termed as the one with highest possible revenue) and the Worst Case (termed as the one with lowest possible revenue) NPV of **+/-$1.648 M** respectively.

Asset Ownership (Business Model)

Model	Non-profit Operated (New)	Existing Non-profit Operated	Privately Owned and Operated	Publicly Owned and operated	Publicly Owned/ Contractor Operated
Potential Funding Sources	State, Federal, Private	State, Federal, Private, Bonds (if authority)	Private	State, Federal, Private	State, Federal, Private
County control over planning and goals	Direct Control/ Indirect Control through Stakeholders	Direct Control/ Indirect Control through Stakeholders	Minimum Control	Direct Control/ Indirect Control through Stakeholders	Direct Control/ Indirect Control through Stakeholders
Potential Regional Expansion	In control of legislation	In control of legislation	Not determined	In control of legislation	Not Determined
Ease of Implementation	Difficult	Dependable on the organization involved	Difficult	Easy	Easy depending upon the availability of funding
Examples of Existing systems	NiceRide (Minnesota)	Charlotte B-Cycle (NC)	CitiBike (NYC)	Hubway (Boston)	Capital BikeShare (Washington D.C)

4.8 Funding Strategies

Virtually all bikeshare systems require external support to sustain operations. Below are some common strategies that our system could pursue.

i. Government Funding

In general, there are many bike share systems that are dependent upon subsidies to operate as membership and advertising fees are not enough. One possible revenue stream could be the funding obtained from government channels such as Tompkins County. There are many bike-share systems that rely on government funding to cover their capital costs. Often, the government then gives out the operational side of the business to a private company. Examples include Mexico, where, 100% of capital investment comes from their city's general budget. Another example for a government strategy includes the bike-share system in Barcelona – Bicing – which receives its funding from the revenue obtained from on-street parking fees by the local authorities.

ii. Loan Financing
Banks can give out loans to cover the initial investments of the bike-share systems. However, most banks provide funds to private companies rather than government or community-based organizations. Potential banks that can be reached out for our system are Elmira Savings bank, CFCU Community Credit Union, Tompkins Trust Company, or M&T Bank, among others.

iii. Sponsorships
Various entities may own assets but seek sponsorship from local or national sources. The biggest example for sponsorship in the USA can be seen from Citibike which has its title sponsored by Citi Group. There are many ways a bikeshare system can receive sponsorship. For instance, branding or naming rights, similar to Barclay's Cycle Hire (London, UK) or logos of company placed on bike stations such as Indigo Bike share. Lastly, we should be aware that sponsorships are risky because it affiliates the system with another company or organization. This could be a potential problem if the image of the associated company or organization is not popular with the local community. For our system, we have identified several sponsors, some of which are Cornell University, Ithaca Hummus, Chobani, and Gatorade.

iv. Private Investment
Depending on the business model, another major funding source could be from Cornell University or perhaps other interested private companies such as Zagster, Motivate etc. This funding could be in the form of full or partial funding which may include capital costs or initial operational costs. Examples of private ownership with university partnership includes Cornell University (Big Red Bikes in association with Zagster), Ohio State University, Yale University, and Texas A&M University.

v. Advertising Revenue
Advertising revenue can come in two different forms – Internal and External. Internal advertisement includes bikes, stations, kiosks etc. whereas the external revenue may come from advertisements in billboards, radios, internet, posters etc. Some systems in China, such as those in Shanghai and Beijing, are considering moving to an ad-based revenue model in the future. Possible advertisement revenue can be generated with good contractual agreements between the system and companies. These may include local companies such as Wegmans, Walmart, Ithaca Hummus, and 7-Eleven.

5. Conclusion

In the beginning of this study we defined the feasibility of a Bikeshare system in the Cornell and Ithaca area by the achievement of three criteria:

i. Interest and demand from the community
ii. Realistic funding amount needed for the system to be implemented and survive
iii. Self-designed "own and operate" model possible

The results of our study have shown that all three can be achieved.

Interest and demand from community

As discussed in section two, market research, there is indeed a large demand for a bikeshare system from the Cornell and Ithaca residents. Out of the 617 responses, 73% of them responded that they would use a bikeshare system if implemented. That number is made even greater by the 24% of responses saying they may use one, leaving only 3% of responses indicating they would absolutely not. What makes the responses even more promising is that 93% of our total responses indicated they are aware of what a bikeshare system is, demonstrating that they know what the system is and want to use one.

Funding needed to implement

To find the profitability we made many assumptions as described previously. From these we were able to come up with revenue projections for the next 14 years, as well corresponding expenses. Finding the net present value for the project we found a value of $380,145 to start the system. Alternatively, this amount is equivalent to an annuity (yearly amount) of $36,250 for 14 years. Both of these values are realistic, as we will be making six figure revenues after a couple years. Thus, we deem this criterion fully met.

Self-designed "own and operate" model possible

After first seeing there was a high demand for a bikeshare system, followed by a realistic amount of funding required, we began designing an operations system. First we defined an organizational hierarchy and offered recommended employees that would run the system. Next we used primarily market survey results as well as intuition to place the dock locations. The layout of the kiosks and docks that users would experience was also explained. This was followed by the actual user experience that someone would encounter. The last operations parts described were the bike technology and the liabilities that we would bear. Ultimately, an operations system is feasible for the Cornell and Ithaca area.

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Appendices

A1. In-depth interview questionnaire:

1 Tell us how do your mode of travel to and from the Cornell University campus? Do you use the same mode for traveling to different buildings in the campus too?
2 Why do you prefer to use the mode of transport that you just mentioned? For example. Is it more convenient and/ or cost effective?
3 Given a chance, what would you like to improve related to the mode of transport that you mentioned before?
4 On an average what is your monthly expenditure on transportation?
5 Do you ride a bicycle? If yes, then given the opportunity, would you like to use a bicycle instead?
6 If Yes, then what are the advantages do you find in doing so? If No, then what are the problems or disadvantages?
7 Have you heard of a bikeshare system? If yes, have you ever had a chance to use a bikeshare system in the past (if no, we'll explain them the system)? If yes, how was your experience?
8 Do you think such a system will be beneficial for Cornell University? If no, why not? If yes, why?
9 Do you think adding motorized bicycles will help solve some of these problems?
10 In your opinion, what can be done to encourage/attract more people to use a bikeshare system?
11 How much would you be willing to spend on a bikeshare system per month?
12 What according to you would be a good schedule for payments? Should it be monthly, semiannually or annually? Or should it simply be on a pay per use basis?
13 What kind of trips would you use the bikes for? For example. Traveling to dining halls, libraries, leisure trips, etc.
14 Any general comments/suggestions that you would like to provide us?

A2. Table of Vendors Contacted

Below is a summarized list of vendors contacted for the information on hardware which also includes

Company Name	Location	Contact Person	Contact Info.	Retail Price Range ($)

bikeshare systems.

1

2

3 4 5 6 7 8 9 10

11

Contact

Company Name Location

Person

Laurence Boxy Bikes Ithaca

Clarkberg Alex Evelo Seattle Stegeman n Trek Bikes

Gary

Ithaca

(Bike Rack)

Weidberg Gary Fisher Gary

Ithaca

(Bike Rack) Weidberg Sacramentio Tim

Pedego , CA Castleman Brookly, Damon GreenPath

NY Sales Rad Power

Seattle Ty Collins

Bikes Connor

NYCE Wheels NYC

Sargent Social Bicycles

NYC

(SoBi)** 8D Montreal, Anthony Technologies Canada Rinaldi

Pawtucket, Patrick On Bikeshare RI Perugini

Contact Info.

laurence@boxybikes.com

18779917272

gweidberg@aol.com gweidberg@aol.com -6103 9173642006 info@radpowerbikes.com connor@nycewheels.com

-arinaldi@8d.com

4014758094

Retail Price Range ($)

2000 -2300

2500 -3500

2800 -5000 2800-5000 2300 -3000 1275 -10,000 1500 1200 -10,000

~ ~ 77,000 (complete package)

BIKES

SOFTWARE & BIKESHARE MANAGEMENT SOLUTIONS

Additional Sources for cheap hardware

1. Wholesale Kiosk from China ($3,000/unit) – Alibaba -http://www.alibaba.com/product-detail/Custom-Payment-Kiosk-Ticket-Vending-Machine_60229756613.html?spm=a2700.7724838.0.0.nSA5Q3&s=p
2. Wholesale E-bikes from China ($360/unit) – Alibaba http://www.alibaba.com/product-detail/European-style-cheap-lithium-battery-e_60614399701.html?spm=a2700.7724838.0.0.pyCESq&s=p
3. Wholesale Smart bike dock from China ($300/unit) – Alibaba -http://www.alibaba.com/product-detail/Custom-Payment-Kiosk-Ticket-Vending-Machine_60229756613.html?spm=a2700.7724838.0.0.nSA5Q3&s=p

GENERAL

City	Country	Project name	Launch Date	# of Stations	# of Bikes in service	# of Docks	C…
Washington D.C.	USA	Capital Bikeshare	September, 2010	238	1,800	3,750	
Guangzhou	China	Guangzhou Public Bicycle	June, 2010	109	5,000	2,298	3

A3. Master data sheet of various bikeshare programs across the world

Hangzhou	China	Hangzhou Public Bicycle	May, 2008	2,700	66,500	n/a	125
Shanghai	China	Not Available	March, 2009	330	28,000	n/a	256
Zhuzhou	China	Not Available	May, 2011	502	10,000	n/a	n/a
Shenzhen	China	Not Available	December, 2011	1,118	9,500	n/a	n/a
Mexico City	Mexico	EcoBici	February, 2010	279	3,200	7,134	19
Rio de Janeiro	Brazil	Bike Rio	October, 2011	56	600	723	20
Buenos Aires	Argentina	Mejor en Bici	December, 2010	28	1,122	n/a	28
Dublin	Ireland	Dublinbikes	March, 2009	44	450	1,105	5
New York City	USA	Citi Bike	May, 2013	323	4,200	9,980	30
Denver	USA	Denver B-Cycle	April, 2010	82	450	1,248	21
Minneapolis	USA	Nice Ride	June, 2010	146	1,380	2,554	70
Chattanooga	USA	Bike Chattanooga	July, 2012	31	235	517	2
Madison	USA	Madison B-Cycle	May, 2011	32	230	490	9
Taipei	Taiwan	YouBike	March, 2009	74	1,000	2,980	24
Brussels	Belgium	Villo!	May, 2009	180	3,500	7,371	73
Tel Aviv	Israel	Tel-o-Fun	April, 2011	125	1,100	3,523	36
Boulder	USA	Boulder B-cycle	May, 2011	22	110	276	2
Boston	USA	Hubway	July, 2011	113	950	1,931	36
San Antonio	USA	San Antonio B-cycle	March, 2011	42	330	637	11
Toronto	Canada	Bixi Toronto	May, 2011	80	660	1,500	11

London U.K. Barclays Cycle Hire July, 2010 554 7,000 14,000 66 5,206 343,596 Serco Group Private Paris France Vélib' July, 2007 1,751 16,500 40,421 135 21,196 2,861,460 SOMUPI (subsidiary of JC Decaux) Private Clear Channel (sub-contracted to Delfin Group) & City of

Barcelona Spain Bicing March, 2007 420 4,100 10,580 41 15,991 652,433 Private

arcelona Lyon France Vélo'v May, 2005 347 3,000 6,400 45 10,101 453,535 JCDecaux Private Montreal Canada Bixi May, 2009 411 3,800 7,760 50 4,518 225,448 Public Bike System Company (Bixi) Public

PERFORMANCE METRICS						PRICING STRATEGY	
City	Trips per Bike	Trips per 1,000 Residents	Station Density	Bikes per 1,000 Residents	Operating Cost per Trip	Annual Pass	24 hours pass
London	3.1	63.9	8.4	23.3	$4.80	$75	$13
Paris	6.7	38.4	13.0	8.4	n/a	_	$2
Barcelona	10.8	67.9	10.3	9.2	$0.86	-	-
Lyon	8.3	55.1	7.7	6.6	$0.86	_	$2
Montreal	6.8	113.8	8.2	22.7	$1.27	$89	$5
Washington D.C.	2.4	18.9	4.2	8.4	$1.52	$85	$8
Mexico City	5.5	158.2	14.9	35.7	$1.28	_	_
Rio de Janeiro	6.9	44.2	2.8	6.4	n/a	-	-
Buenos Aires	3.8	11.2	1.0	2.9	n/a	_	_
New York City	8.3	42.7	10.7	6.8	n/a	$163	$4
Denver	2.8	39.1	4.0	22.0	$3.22	$95	$9
Minneapolis	1.4	10.5	2.1	8.1	$1.52	$75	$6
Chattanooga	2.2	48.3	3.6	25.6	n/a	$50	$8
Boulder	1.0	15.9	9.2	20.8	n/a	$88	$8
Boston	4.0	20.9	3.1	6.1	$3.09	$85	$6
San Antonio	0.4	4.0	3.8	10.6	n/a	$100	$12

bike share

Quotation # : 050517 03 Quotation Date : May 5, 2017	
FOR: Wali Rahman Cornell University Ithaka, NY 14850 **FROM:** Dynamic Bicycles, Inc. 461 Main St, Suite C200 Pawtucket, RI 02860	
Terms Ship Via Sales Rep F.O.B. Project	
30/70 Split (see below) Delivered Patrick Destination Bike Share System	
Qty Description Amount	
1 **64-Bike Point-to-Point, Pay-per-Use System** • *Sixty-Four (64) OBS-7 Unisex Step-thru bicycles featuring Bluetooth locking system, Shimano 7-speed gearing, puncture-resistant tires, fenders, rear basket* • *Twenty-Four (24) x 4-bike docking racks in powder coated Black, with mounting hardware (96 bike docking spots)* • *Rider App for iOS and Android. Unlimited free App downloads, unlimited checkouts/returns* • Admin software including c*loud-based hosting, five (5) Admin logins, phone support, software updates* • *Billing Module (for collecting Rider fees through App) includes customizable billing plan, credit card collection, processing and settlement using Stripe. Credit card processing fees apply.* $74,120	
1 Standard Branding Package • *Bicycles include customer name/logo on frame, fleet numbers* • *Bike racks include top decal with customer name/logo and instructions* INCLUDED	
1 System Configuration • *Setup and custom configuration of customer system in Movatic Software* INCLUDED	
1 On-Site Training (done at time of delivery) • *Training on software, bicycles and system operations.* $1,500 INCLUDED	
1 Delivery (bikes delivered fully assembled and ready to ride) $3,300	
1 TOTAL PURCHASE PRICE (USD$) $77,420*	
Payment Schedule	
30% Deposit to Confirm Order $23,226	
70% Balance Due Net 30 days from Delivery	$54,194

QUOTATION

From Dynamic Bicycles

* *One-time purchase with no recurring fees. Payment of deposit indicates acceptance of payment terms. Quotation valid for 30 days.*

Page **1** of **4**

on bike share

Quotation # : 050517 04 Quotation Date : May 5, 2017	
FOR: Wali Rahman Cornell University Ithaka, NY 14850 **FROM:** Dynamic Bicycles, Inc. 461 Main St, Suite C200 Pawtucket, RI 02860	
Terms Ship Via Sales Rep F.O.B. Project	
30/70 Split (see below) Delivered Patrick Destination Bike Share System	
Qty Description Amount	
1 **32-Bike Point-to-Point, Pay-per-Use System** • *Thirty-Two (32) OBS-7 Unisex Step-thru bicycles featuring Bluetooth locking system, Shimano 7-speed gearing, puncture-resistant tires, fenders, rear basket* • *Twelve (12) x 4-bike docking racks in powder coated Black, with mounting hardware (48 bike docking spots)* • *Rider App for iOS and Android. Unlimited free App downloads, unlimited checkouts/returns* • Admin software including c*loud-based hosting, five (5) Admin logins, phone support, software updates* • *Billing Module (for collecting Rider fees through App) includes customizable billing plan, credit card collection, processing and settlement using Stripe. Credit card processing fees apply.* $40,100	
1 Standard Branding Package • *Bicycles include customer name/logo decal on frame, fleet numbers* • *Bike racks include top decal with customer name/logo and instructions* INCLUDED	
1 System Configuration • *Setup and custom configuration of customer system in Movatic Software* INCLUDED	
1 On-Site Training (done at time of delivery) • *Training on software, bicycles and system operations.* $1,500 INCLUDED	
1 Delivery (bikes delivered fully assembled and ready to ride) $2,300	
1 TOTAL PURCHASE PRICE (USD$) $42,400*	
Payment Schedule	
30% Deposit to Confirm Order $12,720	
70% Balance Due Net 30 days from delivery	$29,680

QUOTATION

From Dynamic Bicycles

* *One-time purchase with no recurring fees. Payment of deposit indicates acceptance of payment terms. Quotation valid for 30 days.*

bike share

QUOTATION

Available Upgrades	Cost
Premium Branding Package (7-speed Model Only) – Add painted fenders and chainguard (color matched to logo), and Branding/Advertising Panels for the rear basket (10 bike minimum)	$125/bike
OnLock™ (7-speed Model Only) – Supplemental Integrated U-lock for riders to secure bike temporarily away from docking stations	$25/bike
Branding/Advertising Signs (7-speed Model Only) – Set of 2 per bike for Left/Right sides of basket, 4-color printed on Styrene	$30/bike
Security Wheel Locks – Set of 4 tamper-resistant axle nuts for each bike. Matching tool $30 (one tool needed per system)	$30/bike
Safety Lights – Reelight SL120 front/rear magnetically powered safety light set	$59/bike
Single Bike Docking Rack – 1-bike docking rack for use with On Bike Share system, with docking pin and branding. Includes concrete mounting hardware	$140
Quad Bike Docking Rack – 4-bike docking rack for use with On Bike Share system, with docking pins and branding. Includes concrete mounting hardware	$395
Bike Repair Stand – Dero Fixit self-service bike repair stand with permanently attached tools, mounts onto concrete, choice of color	$700
Outdoor Tire Pump – Dero Air Kit 2 commercial grade all-season design, mounts onto concrete, choice of color	$400
Tire Pump – T-handle floor standing hand pump	$29

From Dynamic Bicycles

Customize Your System

QUOTATION

From Dynamic Bicycles

Dynamic Bicycles Limited Warranty

Bicycles, racks and system hardware components come with one-year warranty against manufacturing defects or workmanship, limited solely to the repair or replacement of original parts. Warranty claims must be made directly to Dynamic Bicycles. Dynamic reserves the right to request the return of parts claimed under warranty. Warranty does not cover vandalism, theft, damage from accidents, normal wear and tear, neglect, misuse, or failure due to improper assembly, installation or maintenance. Warranty is void if bicycle is modified or used in a manner or purpose other than its original design. Warranty does not include shipping costs.

Limited Lifetime Software License

1. License Use. Movatic grants customer ("Customer") with non-exclusive access to the Movatic software platform ("Software") including App and Administrative software in conjunction with the On Bike Share System. This license includes free unlimited downloads of the Movatic App through the Apple Store (iOS) and Google Play Store (Android), as well as up to five (5) Administrative logins for the Movatic Admin software, limited to the life of the original equipment and Licensed Devices supplied with the On Bike Share system.

This Software license is limited to use only with Licensed Devices included with the On Bike Share system, and cannot be used to control or access any other equipment or devices, unless expressly permitted in writing from Dynamic Bicycles ("Dynamic"). Any new or subsequent equipment purchased for use in the On Bike Share system is subject to this license agreement and may require a one-time license activation. You may not and you agree not to, or to enable others to, copy, decompile, reverse engineer, disassemble, attempt to derive the source code of, decrypt, modify, or create derivative works from the App, Admin software or connectivity between Software and Licensed Devices. This license is non-transferable.

2. Fees Collected. For Customers who use the Billing Module to collect fees from users of their bike share program through the Movatic App, service fees for credit card collections, processing and settlement includes 2.9% plus $0.30 per transaction to Stripe for credit card processing and settlement, plus 3.0% to Movatic for hosting, software support, and upgrades. The net amount of credit card transactions for rider fees collected will be deposited into the Customer's

designated bank account, as established in the Movatic Software by Customer.

1. Covered Software Versions. App users are strongly encouraged to keep up-to-date with App updates in order to ensure the best possible experience with the bike share system.

2. Excluded Services. Excluded from the coverage of this Software License are interruptions in service resulting from misuse or mis-configuration of the Software by Customer, or any accident or other cause external to the Software, including but not limited to problems or malfunctions related to internet interruption, Data Center interruption, Customer's network, information/security breach, credit card processing or settlement delays or interruptions, or other similar causes.

3. Term and Termination. This Software license does not expire, and will continue for the life of the bike share system without license costs. If Customer breaches any terms of this software license, Dynamic and Movatic reserve to the right to terminate Customer access to the Movatic Software and the On Bike Share system.

4. Software Warranty**.** Movatic warrants that the Software will be maintained and supported in a manner in accordance with industry standards.

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Movatic makes no other warranty, express or implied, with respect to the subject matter of the Software and license, including but not limited to any implied warranty of merchantability or fitness for a particular purpose or any other warranty of any kind respecting any services performed herunder or any materials furnished herunder.

5. Limitation of Liability. The cumulative liability of Dynamic and Movatic to customer for all claims arising under or related to this Software license, whether in contract, tort or otherwise, shall not exceed the original Software license fees paid to Dynamic with the original purchase. In no event will Dynamic or Movatic be liable to customer or their end user for damages for loss of data, lost profits, breach of customer or end user information, or other indirect, special, incidental or consequential damages arising from use of the Software, even if Dynamic and Movatic have been advised of the possibility of such damages, or for any claims by any third party. The foregoing limitation of liability and exclusion of certain damages shall apply regardless of the success or effectiveness of other remedies.

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