

WORCESTER POLYTECHNIC INSTITUTE

A Bicycle Share Plan for Worcester Polytechnic Institute

A WPI Interactive Qualifying Project

By Kevin Ackerman and John Colfer

5/13/2015

Advisors: Kristin Boudreau and Dean Richard Vaz

This report represents the work of WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review.

AUTHORSHIP PAGE

This list states the primary author of each section though many sections were edited by both authors.

Kevin Ackerman wrote the portions of the Executive Summary, Introduction, and Background sections 2.1 on current transportation trends and 2.3 on transportation benefits from a bike share. In the Methodology, he wrote 3.1 on university bike shares and 3.4 on implementation plans of a bike share at WPI.

In the Findings, Kevin wrote about benefits of a bike share and challenges of a bike share in 4.1; successful elements, unsuccessful elements, and problems and complications in 4.2; all of 4.3 on the five types of bike shares; all of 4.4 on the Fourteen Essential Aspects of a University Bike Share; sufficient infrastructure, improvements to parking, proposed pathways, bike corral locations, automated bike share locations, Green Team, and funding within 4.5; Main St., sharrows, bike lanes, “share the road” signs, and Blackstone Valley Bikeway within 4.6.

In the implementation plans, Kevin created all documents.

In Appendix B: Implementation Details, Kevin wrote all implementation plans in B.1, B.2, B.3, and B.4 and the helmets section in B.6

Finally, Kevin created the bike rack maps.

John Colfer wrote portions of the Executive Summary, Introduction, and Background sections 2.1 on current transportation trends, and 2.2 on current sustainable transportation practices at WPI. In the Methodology, he wrote 3.2 on the bikeability of Worcester and 3.3 on the bikeability of WPI.

In the Findings, John wrote about uses of a bike share within 4.1; the sections about community members, active groups, equipment, checkout period, and growing demand in 4.2; conditions at WPI within 4.5; strides within Worcester, resources and personnel in Worcester within 4.6;

In the recommendations, John wrote all recommendations.

In Appendix B: Implementation Details, John wrote B.5 on program comparison and B.6 on cost analysis.

Finally, John created the pathway map.

TABLE OF CONTENTS

AUTHORSHIP PAGE	i
TABLE OF CONTENTS.....	ii
LIST OF FIGURES.....	vii
LIST OF TABLES.....	viii
ABSTRACT.....	ix
EXECUTIVE SUMMARY	x
Problem: Unsustainable Transportation at WPI	x
What is Bike Sharing, and How Common Is It?	x
Project Goals	x
Findings	xi
Implementation Plan: Automated Key Box System	xiii
Recommendations	xiii
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: BACKGROUND.....	3
2.1 Current Transportation Trends	3
2.2 Current Sustainable Transportation Practices at WPI	5
2.3 Transportation Benefits from a Bike Share	5
CHAPTER 3: METHODOLOGY	8
3.1 Identify Practices and Challenges of University Bike Shares in the United States	8
How Each Program Was Created.....	8
How Each Program is Currently Run.....	8
Overall Cost of the Program	9
Overall Success of the Program	9
3.2 Assess Current and Future Bikeability of the City of Worcester.....	9
City of Worcester Planning and Regulatory Services Division.....	9
Central Massachusetts Regional Planning Commission (CMRPC).....	9
WalkBike Worcester	9
Worcester Earn-a-Bike.....	10

3.3 Assess Current and Future Bikeability to Identify Benefits and Challenges of a Bike Share on the WPI Campus	10
Administrative Offices and Divisions	10
Student Organizations	11
Other Stakeholders	11
3.4 Develop Implementation Plans for a Bicycle Share Program for the WPI Campus	12
CHAPTER 4: FINDINGS	13
4.1 Benefits and Challenges to a Bike Share at WPI	13
Decrease Single Occupancy Vehicle Use	13
Reduce Strain on Campus Parking	13
Improve the Health of Students and Employees	13
Market WPI to Prospective Students and Employees	14
Decrease the Number of Bikes in Residence Halls	14
Help Residential Services Market Faraday Hall to Students	14
Biking is the Most Efficient Form of Travel Between the Main and Lower Campuses.	14
Users Are Likely To Use a Bike Share for 5 Different Reasons.	15
Challenges to Implementation of a Bike Share at WPI Exist.	19
4.2 University Bike Shares	20
Successful Elements of University Bike Shares	20
Unsuccessful Elements and Desired Improvements of University Bike Shares	21
Bike Shares Are Typically Open to All University Community Members.	22
Successful Bike Shares Are Organized by Strong and Active Leaders or Groups.	22
Proper Equipment and Facilities Are Required to Maintain Bikes in a Bike Share.	23
The Length of Time Users Can Take Out a Bike Depends on the Type of Bike Share and the Goals of the Program	24
The Due To Increasing Demand, Bike Shares Typically Increase the Number of Bikes in the Program of Time.	25
4.3 The Five Types of Bike Shares	26
Ad Hoc	26
Bike Corral	26
Kiosk	27
Automated Key Boxes	27

Tech-on-Bike	29
Due to Problems and Complications With Bike Corral Systems, Some Schools Have Switched to Automated Bike Share Systems.....	30
4.4 Fourteen Essential Aspects of a University Bike Share	30
1. Bike Share System.....	31
2. Bike Sign Out / Log Method	31
3. Bike Locations (number and placement).....	31
4. Bike Locks.....	31
5. Bike Type.....	32
6. Number of Bikes	32
7. Bike Share Operator(s)	32
8. Bike Share Users	32
9. Checkout Time	32
10. Checkout Format	33
11. Cost to User	33
12. Workshop Space and Maintenance.....	33
13. Winter Storage Space	34
14. User Sign-Up, Liability, & Education	34
4.5 Current and Future Bikeability of the Worcester Polytechnic Institute campus.....	34
Conditions at WPI Appear to Support a Bike Share.	34
There is Sufficient Infrastructure to Support Growth in Bicycle Use on the WPI Campus. ..	34
Improvements to Parking on the WPI Campus Have and Will Continue to Make Travel Safer for Pedestrians and Bicyclists.	36
The Proposed Pedestrian Pathway Connections of the 2014 Addendum to the Campus Master Plan Would Increase the Bikeability of the WPI Campus.	37
Many Recommended Housing, Academic and Research, and Campus Life Sites Exist Toward the Peripheries of Campus and Could Increase the Applicability of Riding a Bike to Locations on Campus.	41
4.6 WPI Organizations Interested in a Bike Share.....	45
The Student Green Team, A WPI Student Organization, is Interested in Operating the Bike Share.....	45
The Fitness Club, a WPI Student Organization, is Interested in Using the Bike Share.....	45

The WPI Student Government Association (SGA) and Graduate Student Government (GSG) Have Expressed Interest in Helping Fund a Bike Share.	45
4.7 Current and Future Bikeability of Worcester, Massachusetts	46
The City of Worcester is Making Strides to Become More Bike Friendly	46
Worcester Does Not Yet Have the Resources or Personnel to Focus on Bicycling Full Time.	48
CHAPTER 5: IMPLEMENTATION PLANS.....	49
CHAPTER 6: RECOMMENDATIONS	55
We recommend a bike share for all students, faculty and staff be implemented at WPI.	55
We recommend that the WPI bike share be jointly funded by the university, Student Government Association (SGA), and Graduate Student Government (GSG).	55
We recommend one of the Implementation Plans laid out in this document be executed. ...	55
Specifically, we recommend the web-based automated key box system be implemented. ...	56
We recommend the bike share be operated by the WPI Student Green Team with the assistance of a faculty and / or staff advisor.....	56
We recommend additional bike racks be installed at Gateway Park to accommodate increased bike traffic.....	56
APPENDIX A: IMPLEMENTATION DETAILS	57
A.1 Bike Corral	58
A.2 Tech-on-Bike	61
A.3 Automated Key Box – PC Based Management Software	64
A.4 Automated Key Box – Web Based Management Software	68
A.5 Program Comparison	72
A.6 Cost Analysis and Comparison	72
Helmets.....	73
Tools and Materials	74
Bike Corral.....	74
Automated Key Box	75
Tech-on-Bike	75
APPENDIX B: INTERVIEW QUESTIONS	76
B.1 Questions for University Bike Program Operators	76
Email Interview with Worcester State University Bike Share	76

Email Interview with Rochester Institute of Technology Bike Share	77
Phone Interview with Wellesley College Bike Share	78
Interview / tour, Clark University bike share, Cycles of Change	80
Email Interview with Tufts University Bike Share “Tufts Bikes”	82
Phone Interview with NYU Bike Share	83
Phone Interview with Sustainability Coordinator, Skidmore College	85
Phone Interview with Zagster Bike Share Company	89
Phone interview with On Bike Share	91
Interview with Zagster Bike Share Company.....	94
B.2 Questions for Local and Regional Officials.....	95
Interview with City of Worcester Planning Board - Director and Sustainability Project Manager.....	95
Interview with CMRPC and WalkBike Worcester	97
Interview with Worcester Earn-a-Bike	99
B.3 Questions for WPI Stakeholders	101
Interview with Dean Joseph Sarkis and William O’Brien, of the Robert A. Foisie School of Business	101
Interview with the WPI Dean of Students	103
Interview with the WPI Vice President of Human Resources	104
Interview with WPI Green Team Officers.....	105
Notes from Green Team General Body Meeting.....	106
Interview with Professor John Orr, Co-Chair of the WPI Sustainability Task Force	107
Interview with the WPI Office of Admissions Staff Members.....	108
Interview with Alfredo DiMauro, Assistant Vice President for Facilities, President’s Task Force on Sustainability	109
Interview with WPI Fitness Club Officers	113
Interview with the WPI Student Government Association Committee on Student Life Issues	113
Interview with an Assistant Director of WPI Residential Services	114
Interview with the WPI Student Government Association Treasurer and Committee on Fiscal Responsibility and Assistance (CFRA)	116
Interview with the WPI Police Department	117

Interview with Graduate Student Government (GSG) Officers.....	118
BIBLIOGRAPHY AND PHOTOGRAPH SOURCES.....	120

LIST OF FIGURES

Figure 1: Daily Commuting Methods of the WPI Community.	3
Figure 2: Travel Methods to Gateway Park	4
Figure 3: Percentage of survey respondents who would change the way they travel if a bike share were implemented.....	6
Figure 4: Breakdown by WPI community group on whether a free or inexpensive bike rental change the way they travel.....	6
Figure 5: Car trips between the main campus and Gateway Park saved if a bike share were implemented.....	13
Figure 6: Trips analyzed via walking, biking, and driving. Clockwise from top left: Faraday Hall and the Sports and Recreation Center; Gateway Park and Sports and Recreation Center; Gateway Park and the Rubin Campus Center; Faraday Hall and the Rubin Campus Center	14
Figure 7: Travel times to and from Faraday Hall (left) and Gateway Park (right)	15
Figure 8: Bike route from library on the main campus to Gateway Park on the lower campus (left) and Bike route from library on the main campus to Faraday Hall, an upperclassmen residence hall (right)	16
Figure 9: Bike route from library on the main campus to Price Chopper, a frequent route taken by WPI students (left) and bike route from the main campus to the approximate center of Shrewsbury Street (right).....	16
Figure 10: Maps showing restaurants in Worcester around the WPI area. Restaurants are denoted by red dots (left) and map showing shopping locations in Worcester around the WPI area. Shopping centers are denoted by blue dots (right) (Restaurants Map [Image]; Shopping Map [Image]).....	17
Figure 11: Maps showing the 15 minute bike ride from WPI to Clark University (left) and the 10 minute bike ride from WPI to Union Station (right)	17
Figure 12: Map showing the bike ride from WPI to Salisbury Estates	18
Figure 13: Potential biking route to downtown Worcester 3.6 miles.	18
Figure 14: Checkout period at various example universities.....	24
Figure 15: Number of bikes per 1000 people at case study university bike shares.	25
Figure 16: Current locations of bike racks on the WPI main campus.....	35
Figure 17: Current locations of bike racks on the WPI lower campus.....	35
Figure 18: Improvements to parking on the WPI campus since the development of the 2004 Master Plan.	36
Figure 19: Addendum to the 2004 WPI Campus Master Plan.....	37
Figure 20: Current and proposed future pedestrian pathway connections in addition to building and garage development sites for the WPI campus.....	38

Figure 21: Current Walking- and biking-friendly paths on the WPI main campus, with indications of future bike-friendly expansions.....	38
Figure 22: Current pictures of each side of Earle Bridge. Note the ramp on the east (left) side and staircase on the west (right)	39
Figure 23: Potential walking- and bike-friendly paths on the WPI main campus, if bike-friendly expansions completed	40
Figure 24: Current staircase across the street from Faraday Hall. A proposed improvement includes replacing the staircase with an accessible ramp.	40
Figure 25: From top left continuing clockwise: Housing growth sites, academic and research growth sites, and campus life growth sites surrounding WPI.	41
Figure 26: Main Street, Worcester, MA.....	46
Figure 27: Sharrows in Worcester on (left to right) West St, North Ashland St. and Lincoln St. .	46
Figure 28: Bike Lanes, Worcester, MA. From left to right: Elm St., Temple St., Harding St., and Green St.	47
Figure 29: "Share the Road" signs in Worcester, MA. From left to right: Salisbury St. across from Tuckerman Hall, Green St., and Grove St. by Faraday Hall.....	47
Figure 30: Automated Key Box from On Bike Share	65

LIST OF TABLES

Table 1: Distances measured from the center of campus (Rubin Campus Center) to each location. Distances are provided for walking and bicycling.	4
Table 2: Successful elements of case study university bike shares	20
Table 3: Unsuccessful elements and desired improvements of university bike shares.....	21
Table 4: Comparison between Ride-and-Return and Station-to-Station systems	33
Table 5: Building Operating Hours for Potential WPI Bike Corral Locations	42
Table 6: Bike Location Comparison for a WPI Bike Corral System	43
Table 7: Bike Location Comparison for an Automated Bike Share System at WPI	44
Table 8: Comparison of attributes of each implementation plan	54
Table 9: Recommendations for the 14 Essential Aspects of a University Bike Share	57
Table 10: Comparison of bicycles for each implementation plan	72
Table 11: Total cost breakdown for each system	73
Table 12: Costs of tools needed for a bike share.....	74
Table 13: Costs of bike repair materials	74

ABSTRACT

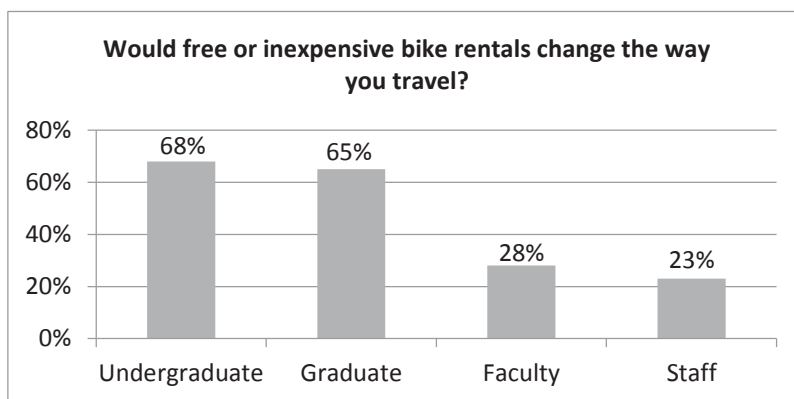
This project, sponsored by the WPI Department of Facilities, proposes a bike share program to promote sustainable transportation at WPI. We interviewed operators of other university bike shares to determine which aspects of their programs were successful and unsuccessful and how they correlate to WPI. We consulted with key stakeholders at WPI to learn how a bike share could benefit the campus and to identify the challenges to successful implementation. We conferred with Worcester government and regional officials, and representatives of local bicycle advocacy groups to determine the state of biking in Worcester. Based on our findings, we ascertained the essential aspects of a university bike share and produced implementation plans for a bike share at WPI.

EXECUTIVE SUMMARY

Problem: Unsustainable Transportation at WPI

A 2014 Interactive Qualifying Project (IQP) about transportation on the WPI campus found that 50% of WPI community members travel between the main campus and the Gateway Park on the lower campus at least occasionally and of these people, about 25% regularly drive a car. One of this 2014 study's main recommendations was to create a free or inexpensive bicycle share to service the WPI community.

According to the report, two-thirds of students and a quarter of employees responded that they would take advantage of a bike share if it was available. In the WPI Sustainability Plan, the university recognizes unsustainable transportation as a problem and has a stated goal in the plan to decrease vehicle use and increase biking on campus.



What is Bike Sharing, and How Common Is It?

The fundamental idea of bicycle sharing is that members of a community can use a bike for a set period of time for whatever they need and then return it for others to use. Bike sharing, as it is commonly called, currently exists at over 150 universities in the United States alone as well as many major cities and corporations. In fact within Worcester, both Clark University and Worcester State University have bike shares on their campus.

Project Goals

In researching this issue, we developed the following goals.

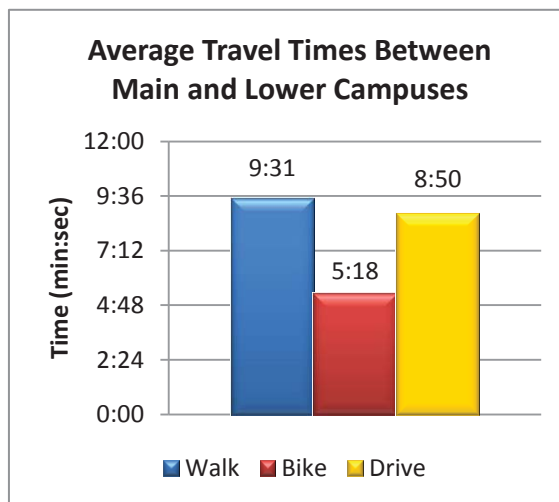
- 1) Assess the benefits and challenges of bike sharing at WPI.
- 2) Ascertain the current and future state of biking at WPI and the City of Worcester.
- 3) Research existing bike rental systems
- 4) Develop a set of implementation plans for a WPI bike share.

To fulfil these goals, we conducted interviews with members of the WPI administration and student body, Worcester government and regional officials, bike advocacy groups, and operators of other university bike shares.

Findings

Benefits

Having a bike share would **decrease single-occupancy vehicle use**; per academic year, over 4600 car trips would be saved between the main campus and Gateway Park (lower campus) alone. It would **reduce strain on campus parking** because less parking would be needed for those driving between campuses. The reduction of vehicle use not only improves the sustainability of WPI through **decreased adverse environmental impact** but also **makes the campus and surrounding roads safer for pedestrians**. Due to the increased physical exertion required to bike when compared to driving, a bike share would **improve health of students and employees**. Because WPI would be a “greener”, most sustainable university, a bike share would assist Office of Admissions and Human Resources **market WPI to prospective students and employees** respectively. Residential Services has stated a bike share would **decrease number of bikes in residence halls** and help solve the problem of decreased space and roommate conflicts. Finally a bike share would enable people to **save time**. Compared to walking, driving only saves an average of 41 seconds (between main and lower campus). Biking is 44% faster than walking and 40% faster than driving.



Uses

As previously mentioned, a need through decreasing unsustainable transportation and a desire exists for a bike share for **inter-campus travel**. Other uses include traveling into Worcester to **groceries, shopping, and restaurants** and to other locations such as to **jobs, other universities, and Union Station**. Some interviewees expressed interest in riding a bike between **campus and off-campus apartments** during the day. Finally, many interviewees foresaw bike share use for **exercise & leisure**.

Challenges

Among the identified challenges to a bike share at WPI are the natural conditions such as **hills and weather**. These challenges do not necessarily inhibit a bike share from being successful. Many bike shares exist in regions similar to Worcester, let alone two other bike shares in the city itself. Regarding weather, most bike shares in the northeast close for the winter term (WPI's C term) and open after spring break (WPI's D term). Other challenges include a **perceived lack of bike infrastructure** in Worcester, **bad habits among drivers and bicyclists**, and **bike theft**. These three challenges can be minimized through user education when community members sign up for the bike share.

Other University Bike Shares: Most and Least Successful Elements

By interviewing operators of other university bike shares, we learned what aspects had been successful in order to emulate those in the plan for a WPI bike share. Just as importantly, we

learned what was unsuccessful about other bike shares in order to account for and avoid these difficulties in the WPI bike share plan.

Successful Elements	Unsuccessful Elements
Bikes used as an alternative to driving	Low quality bikes
Open to all university community members	Lack of user education
Run by committed student organizations	Lack of bike repair infrastructure
High visibility sustainability initiative	Inconvenient helmet distribution
Improve student life	

Types of Bike Shares

We identified five types of bike shares that could be implemented at a university. We evaluated each system based on the needs and uses of a bike share at WPI.

Bike Share System	Main Problem
Ad Hoc	Bike theft
Kiosk	High infrastructure cost
Bike Corral	Limited locations, hours; no location possible on WPI lower campus
Tech-on-Bike	Very high annual cost
Automated Key Box	

The first four systems each have at least one problem that would restrain start-up or use of the bike share while the automated key box system does not and is our recommended bike share system for WPI.

14 Essential Aspects of a University Bike Share

Through our research of other university bike shares, we determined the fourteen essential aspects of a university bike share. In order to implement a bike share at a university, each of the fourteen criteria must be considered. We developed our implementation plans according to these criteria.

Current and Future Bikeability of WPI

To determine if the WPI campus could facilitate increased bike use, the location and number of bike racks was assessed. Sufficient bike infrastructure does exist on campus with a **maximum bike capacity of 250 bikes**. Removal of parking, both past and future, increases safety of travel by bicyclists and pedestrians: **250 parking spaces have been removed from campus core since 2004**. Planned accessibility improvements to Earle Bridge and by Faraday Hall will also improve bike-friendly paths.



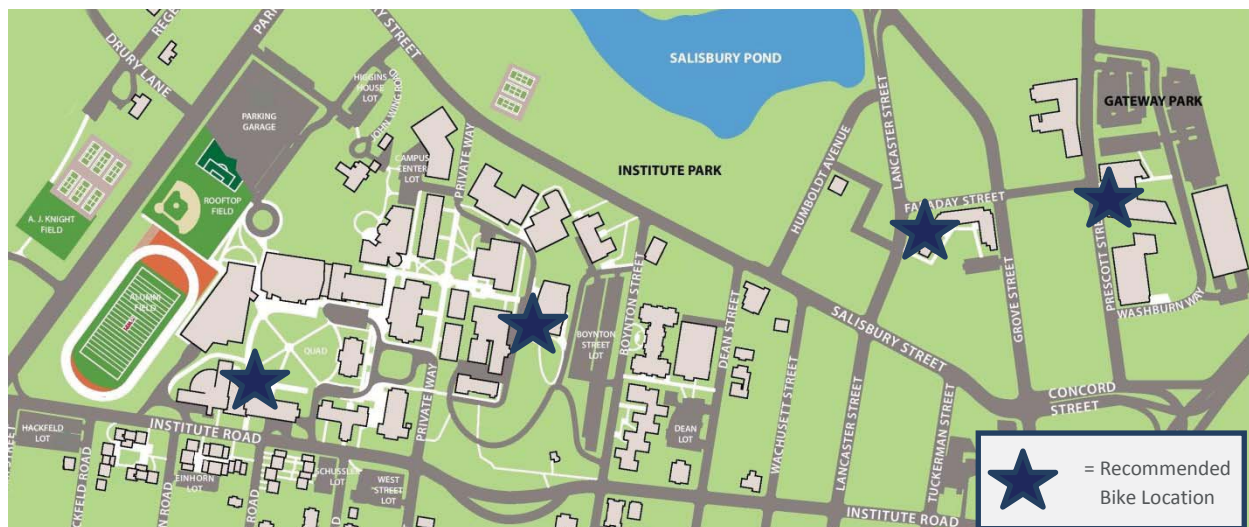
Current and Future Bikeability of Worcester

Existing bike infrastructure include “share the road” signs, shared-lane arrows, bike lanes, and bike racks at many public buildings. Current projects under construction or in planning include

connection to the Blackstone River Bikeway, a planned continuous bikeway between Worcester and Providence, RI, and a renovation of Main Street which will include the addition of bike infrastructure and some form of traffic calming.

Implementation Plan: Automated Key Box System

This is an automated system, operated 24/7 with real-time data collection, in which users have a PIN which they enter into a key box on top of a bike rack in the share that contains the key for the bike locked on that rack. Upon receiving the key, the user is free to use the bike for a given amount of time and then the bike must be returned to the original bike rack. Our recommended bike share locations are at areas of a high concentration of potential users. These locations include (from left to right) the quad, with close access to four of five freshman residence halls and two upperclassman residence halls as well as all users of the quad and those eating in the dining hall; the library on the academic portion of campus for close access for the thousands of students of employees going to class every weekday; Faraday Hall for the more than 250 residents; and Gateway Park for the more than thirty faculty, fifty graduate students, and additional staff (WPI Residential Services, n.d.).



Advantages: This **automated** system is **modular** and **scalable** since locations can be installed anywhere one could install a normal bike rack. The included bike is designed for a bike share and is **easy for a variety of users to ride**, **durable**, and has an **internal gear hub** and a **rear basket**.

Recommendations

Based on our findings, we recommend:

A bike share for all students, faculty, and staff be implemented at WPI. All WPI community members could benefit from the aforementioned uses and significant portions of each have said they would use a bike share.

One of the implementation plans laid out in this document be executed. The implementation plans were created so that all factors for a WPI bike share were considered and laid out. Once

funding is established, almost all the information needed to start and operate the bike share is included.

Specifically that the web-based automated key box system be implemented. This is our recommended system for a WPI bike share.

The WPI bike share be jointly funded by the university, Student Government Association (SGA), and Graduate Student Government (GSG). Both SGA and GSG have expressed interest in funding a portion of a bike share, proportional to the number of represented users (undergraduate students represented by SGA and graduate students represented by GSG), and available funds.

The bike share be operated by the WPI Student Green Team with the assistance of a faculty and / or staff advisor. The Green Team is interested in operating the WPI bike share if implemented. Additionally, to maintain continuity of leadership during Green Team officer transitions, we recommend at least one faculty or staff member advise and supervise the bike share.

Additional bike racks be installed at Gateway Park to accommodate increased bike traffic. The current bike racks are often at capacity so with increased traffic to Gateway, additional bike racks would be needed.

CHAPTER 1: INTRODUCTION

Colleges and universities place importance on sustainability and in particular, Worcester Polytechnic Institute (WPI) has made a commitment to developing and expanding sustainability measures across its campus. According to the WPI Sustainability Plan, written by a team of faculty, staff, students, and administrators, the institution commits itself to the preservation of the planet through the implementation of sustainability throughout the campus. This plan, supervised by the WPI Task Force on Sustainability, aims to promote and implement sustainability across the campus within academics, campus operations, research, and community engagement (“WPI Sustainability Plan,” 2013).

The College Sustainability Report Card grades universities based on sustainable practices. The Report Card provides grades in categories including food & recycling, green building, student involvement, transportation, endowment transparency, and investment priorities and as such is a measurement of the extent to which sustainable practices are manifested at WPI. One category in which WPI has room for improvement is transportation. According to the report, there is a high percentage of students and employees who commute to school and work in single-occupancy vehicles; 52% of students and 95% of employees drive (“The College Sustainability Report Card,” 2011). Another cause for a low grade is due to limited promotion of biking around campus.

A 2014 study titled “Promoting Alternative Transportation for the WPI Community” studied various forms of alternative transportation currently in use at WPI and probed potential use of alternative transportation. The study also found a high use of personal vehicles on the WPI campus. Though many students and some faculty and staff walk to campus, only 2% ride a bicycle, 1% carpool, and less than 0.5% takes public transportation (Cyr et al., 2014). There is considerable improvement to be made in terms of sustainable transportation at WPI.

The 2014 report recommends a “bicycle rental program” as a means to improve transportation on the WPI campus. This kind of program is commonly referred to as a “bike share.” In its most general sense, a bike share operates such that users of the program can sign out a bike for personal use for a set amount of time and then return the bike for others to use.

A 2012 study entitled “A Bikeway Network for the City of Worcester” conducted a survey of members of the WPI community and members of other Worcester universities about biking in city of Worcester. The results of this study suggest that WPI community members living on campus and off would travel to many places within the city if they had access to a bike, including shopping centers, cultural centers, parks and recreation areas, transportation hubs, medical facilities, other Worcester universities (Capizzio, Hunter, Martin, & Miller, 2012). In the Cyr et al. study, respondents were asked how they usually travel during the day, away from campus. Though 87% of respondents always or sometimes walk, as many as 67% ride in a personal vehicle. Less than 3% of respondents always ride a bicycle of the 13% bikes (Cyr et al., 2014).

Though the current usage of bicycles is low, studies show that members of the WPI community would be interested in biking as a means of transportation. The survey of WPI students and employees conducted by Cyr et al. found that 54% of respondents would take advantage of a free or inexpensive bike share if it were implemented at WPI (Cyr et al., 2014). Based on the Capizzio et al. report, 91% of survey respondents declared affiliation with a Worcester university and 75% declared affiliation with WPI. Their findings were consistent with those of the Cyr, et al. report, in suggesting that there is a clear interest in bicycling around Worcester and WPI. As many as 90% of people surveyed indicated that they would use biking as a means to travel within Worcester and 65% indicated that they would take advantage of a bicycle rental system if it was available to them.

Municipalities and universities around the United States have implemented such programs with great success. One example is the Hubway, a bike share program for the city of Boston. The Hubway has 140 bicycle stations supporting 1300 bikes around greater Boston, allowing the approximately 71,000 unique users to travel throughout the city quickly and sustainability ("Hubway Media Kit," 2014). Over 150 universities have bike share programs, each of which differs in organization, policy, size, and bike use ("The College Sustainability Report Card," 2011). New York University (NYU), located in a city of 8 million people and a university population of over 70,000 has a popular bike share. On the other end of the spectrum, Skidmore College has a successful bike program despite a small population. Clark University and Worcester State University both have successful bike shares that operate in the city of Worcester.

This study analyzed the uses, benefits, challenges, and strategies of a bike share. The goal of this project was to develop a set of implementation plans for a bicycle share program for the WPI campus. These plans include evaluations of the cost, benefits, and logistics of a bike share program.

CHAPTER 2: BACKGROUND

The WPI Sustainability Plan, written by a team of faculty, staff, students, and administrators, represents Worcester Polytechnic Institute's (WPI) commitment to the implementation of sustainability practices throughout its campus. This plan contains a goal to reduce single-occupancy vehicle use and increase bicycle use at WPI ("WPI Sustainability Plan," 2013). This chapter contains an overview of transportation habits at WPI, sustainable transportation options, and bike sharing. This data was then used to define our research goals.

2.1 Current Transportation Trends

Those who live, work, and study at WPI face the daily decision of how to travel to, from, and around the WPI campus. According to the *Sierra Magazine*, about 25% of students and 95% of employees at WPI commute to campus by personal vehicle (Sierra Club, 2010). This results in a high usage of personal vehicles on the WPI campus. Figure 1 shows the transportation habits of WPI community members. This is based on the Cyr et al report, the respondents of which were 40% undergraduate students, 14% graduate students, 22% staff members, and 11% faculty members (Cyr et al., 2014). The data shows that driving to campus is the most popular form of commuting to WPI, while the amount of people biking is comparable to those who carpool and take public transportation:

Methods of Commuting to WPI

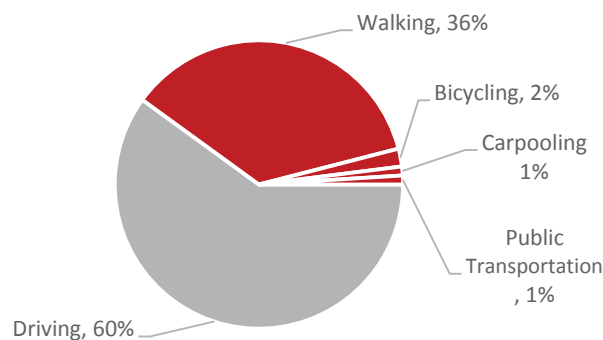


Figure 1: Daily Commuting Methods of the WPI Community.

The results of this study indicate that a bike share program on campus would have a greater effect on how people travel on and around the campus than how they commute.

The Capizzio et al study, suggests that WPI community members would travel to many places within the city if they had access to a bike rental system (Capizzio, Hunter, Martin, & Miller, 2012). Many people travel around Worcester during the day, whether it is to restaurants, grocery stores, shopping locations, or the WPI satellite campus at Gateway Park. The distance from the center of campus, the Rubin Campus Center to the various locations is provided in Table 1. The distance to Price Chopper is 0.53 miles, and to the Highland Street restaurants

("USATF - America's Running Routes - Map It", 2014). The distance to the center of Shrewsbury Street is 2.2 miles, to Worcester's Union Station is 1.6 miles, and to the Lincoln Street Plaza is 2.6 miles ("Google Maps," 2014).

Table 1: Distances measured from the center of campus (Rubin Campus Center) to each location. Distances are provided for walking and bicycling.

Location	Distance Walking	Distance by Bicycle
Highland Street Restaurants	0.32 miles	0.32 miles
Price Chopper	0.53 miles	0.56 miles
Shrewsbury Street Restaurants	2.0 miles	2.2 miles
Lincoln Street Plaza	2.8 miles	2.8 miles
Union Station	1.5 miles	1.6 miles
Gateway Park	0.55 miles	0.70 miles

Potentially the most popular route for WPI travelers during the day is to Gateway Park, located a little over a half-mile from the main campus. Gateway Park which houses laboratories, offices, a lecture hall, and a parking garage is visited by students, faculty, and staff. According to Cyr et al, 50% of WPI community members travel to Gateway Park at least occasionally. Figure 2 shows the popularity of methods to get to Gateway Park during the day, based on the data from Cyr et al. This high amount of personal vehicle use between the main campus and Gateway Park in a personal vehicle represents unsustainable transportation.

Methods of Travelling to Gateway Park

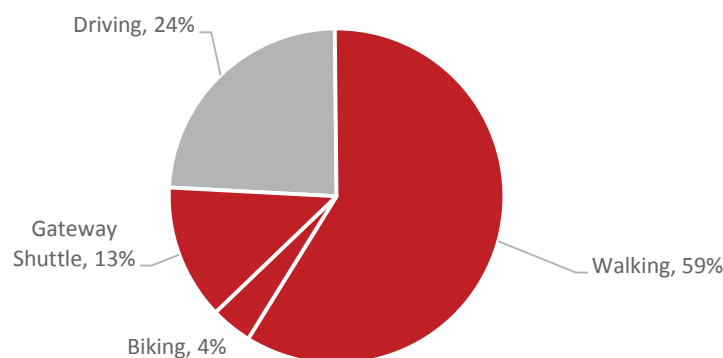


Figure 2: Travel Methods to Gateway Park

Furthermore, the walking distance required from Gateway Park to one's car in the Gateway parking garage as well as distance from the Park Avenue parking garage to the campus center 0.36 miles, already 65% of the walking distance between the centers of the two campuses ("USATF - America's Running Routes - Map It", 2014). In addition, many survey respondents expressed dissatisfaction with the shuttles between the main campus and Gateway Park. Complaints included long wait times, poor departure and arrival times, and long travel times (Cyr et al, 2014).

Located 0.42 miles on foot or 0.54 miles on bike from the center of the main campus, WPI's most distant residence hall, Faraday Hall is located between campuses but in the vicinity of Gateway Park and the lower campus ("USATF - America's Running Routes - Map It", 2014). Though the number of students who drive to campus from Faraday Hall has not been quantified, for those who do, the walking distance required to the Faraday parking lot and from a campus parking lot to the campus center represents 70-80% of the walking distance required directly from Faraday to the campus center ("USATF - America's Running Routes - Map It", 2014). Faraday Hall houses up to 258 students which represent another considerable population of potential bicycle share users (WPI Residential Services, n.d.). Therefore, there is a need for fast, sustainable, reliable transportation between the main campus and lower campus.

2.2 Current Sustainable Transportation Practices at WPI

This section of our report focuses on how the school promotes alternative transportation through its policies and practices. The College Sustainability Report Card provides grades in categories such as green building, student involvement, and transportation. As such it is a measurement of the extent to which sustainable practices are manifested at WPI. One category in which WPI did not receive a high score is transportation. According to the report, WPI has a high percentage of students and employees who commute to school and work in single-occupancy motor vehicles, 52% and 95% respectively ("The College Sustainability Report Card," 2011). WPI does provide services such as carpool incentives, shuttles to some locations on campus, and car-sharing.

Currently, WPI presents three options to promote sustainable transportation. The university promotes use of alternative-fuel vehicles by providing electric car charging stations and hybrid-fuel vehicles in the Zipcar fleet. WPI incentivizes alternatives to driving to and from campus, with incentives for public transportation, college-operated shuttles, and reduced-rate parking for carpools. According to the Report Card, campus planning policies promote a pedestrian- and bike-friendly environment as well as bike repair services ("The College Sustainability Report Card," 2011). The WPI administration is interested in providing alternative transportation options to members of the community.

2.3 Transportation Benefits from a Bike Share

This section details how a bike share system would affect the WPI community. The previous two sections analyzed transportation habits and options on campus and identified areas of improvement for on-campus transit. The use of a bike share program would directly fulfill these

goals. A bike share program could reduce single occupancy motor vehicle use and allow students to directly improve the sustainability of the campus.

A survey by the National Highway Traffic Safety Administration found that the number one reason for not riding a bike is lack of access to one (Royal & Miller-Steiger, 2008).

The Cyr et al. report found that 54% of the WPI community would change the way they travel if a bike share were implemented as seen in Figure 3.

Would free or inexpensive bike rentals change the way you travel?

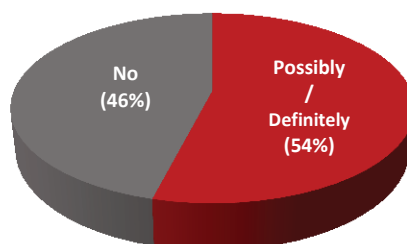


Figure 3: Percentage of survey respondents who would change the way they travel if a bike share were implemented.

Further analysis of the data for this question seen in Figure 4 shows the percentage of each group; undergraduate students, graduate students, faculty, and staff.

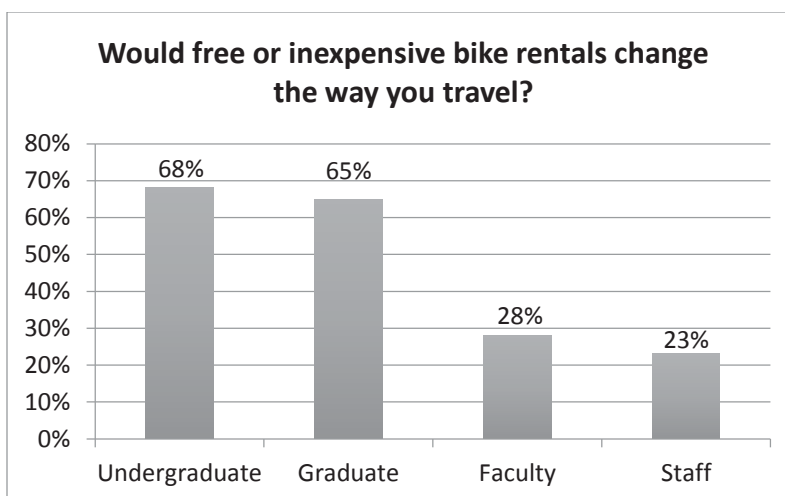


Figure 4: Breakdown by WPI community group on whether a free or inexpensive bike rental change the way they travel.

The College Sustainability Report Card cites the lack of a bike share at WPI as a gap in sustainable practices on campus ("The College Sustainability Report Card," 2011). This is in alignment with the WPI Sustainability Plan, which specifically calls for a bicycle sharing program as a part of its goal for improving sustainability in transportation ("WPI Sustainability Plan," 2013). A bike share would help make WPI a more sustainable campus in a few ways. A bike share could reduce the use of single-occupancy vehicles on campus, as suggested by Cyr et al. The implementation of a bicycle program would assist in developing a culture of sustainability

on campus. Part of education is the student living experience, and the availability of sustainable transportation such as bicycling would provide students the opportunity to live sustainably, and put what they learn into practice ("WPI Sustainability Plan," 2013).

Bicycling would be a sustainable alternative for Gateway Park travelers, as it would make the trip between campuses much shorter for walking, and would reduce use of single-occupancy vehicles (Capizzio et al, 2012). It would also be a sustainable alternative for travelers going between the campuses. In their report, Capizzio et al recommends biking as a means of getting around in Worcester. The report analyzes traffic conditions in the city, as well as WPI community members' interest in biking. According to the report, there is a growing movement in the Worcester government to improve bicycle transportation, in order to alleviate some of the city's traffic issues (Capizzio et al., 2012). Cyr et al recommends creating a free or inexpensive bike rental system to reduce single occupancy vehicle use on the WPI campus. The use of unsustainable transportation occurs both to and between campuses as around one quarter (24%) of travelers to Gateway Park ride in a personal vehicle (Cyr et al, 2014). The addition of a bike share program and increased use of bicycles would likely reduce unsustainable transportation practices.

CHAPTER 3: METHODOLOGY

The goal of this IQP was to develop a bicycle share implementation plan for the WPI campus. This plan includes evaluations of the uses, challenges, benefits, and essential aspects of a university bike share program. We evaluated multiple alternatives and then presented a set of recommendations. To accomplish this goal, the team completed the following research objectives.

3.1 Identify Practices and Challenges of University Bike Shares in the United States

In order to make educated recommendations about the logistics of a bike share program we researched the programs that already exist. We determined the most and least successful aspects of each program, and the challenges that each program faced.

We studied in depth the bike share programs at Worcester State University, Clark University, New York University, Rochester Institute of Technology, Skidmore College, Tufts University, and Wellesley College. These schools were selected due to their similarity to WPI, presence in the city of Worcester, and/or interesting characteristics.

After gathering as much information on bicycle programs made available to the public through websites, news articles, blogs, and social media sites, information was gathered through interviews with bike share operators each university. Interviews were conducted by in person, by phone, or by email depending of the preference of the operator. The interviewees had the option of keeping the identity of themselves and of their university anonymous.

The following consist of the four main factors for about which we wanted to learn from university bike share operators. For a full set of interview questions, see Appendix section B.1 Questions for University Bike Program Operators.

How Each Program Was Created

Information on the inception of case study university bike share programs provided insight into the bike share elements considered during implementation. These elements were used to develop a list of essential aspects of a university bike share. We asked questions pertaining to the groundwork each program laid and how each school's different characteristics contributed to the details of the program. We ask what each school in retrospect would have done differently when implementing their bike share.

How Each Program is Currently Run

We hope to borrow details of the most successful programs in making our recommendations for how a program at WPI could be structured. The most important question asks for details on the organization and operation of each program. Organizational details include the day-to-day management, operating schedules, and program restrictions.

Overall Cost of the Program

We sought to learn how much bike shares programs or individual components cost. Components such as infrastructure, maintenance, and annual operation contribute to this total cost. A university may or may not be willing or able to pay for this kind of program, depending on the price. Additionally, we sought to learn what cost is applied to users at other universities, and who bears that cost.

Overall Success of the Program

Overall success is a difficult entity to quantify, but we sought to obtain a qualitative understanding of what benefits the program has had on its users and the university. By determining what has been successful and unsuccessful at other universities, we can develop recommendations for a successful bike share program at WPI.

3.2 Assess Current and Future Bikeability of the City of Worcester

Plans of the city of Worcester would have an impact on a bike share program at WPI. As WPI resides in an urban area, bike paths and lanes, traffic patterns, and winter weather affect the use of a bike share program. We sought to learn about the current and future bikeability of Worcester.

We collected information by way of interview as we were seeking detailed information on broad questions. Using this method, the interviewees are able to expand on their ideas verbally as opposed to in writing, and the interviewers were allowed to ask follow-up questions. For example questions see Appendix section B.2 Questions for Local and Regional Officials. We conducted interviews with the following groups:

City of Worcester Planning and Regulatory Services Division

The Planning and Regulatory Services Division is in charge of all planning for infrastructure in the city. We sought to learn what steps they are taking, if any, toward making Worcester a more bikeable city. We were interested in current and future projects related to biking in Worcester.

Central Massachusetts Regional Planning Commission (CMRPC)

The CMRPC is a regional entity that is involved in planning events in the Central Massachusetts area. We are sought information on what projects they are or will be working on related to biking.

WalkBike Worcester

WalkBike Worcester is an advocacy group dedicated to improving walking and biking in Worcester. We wished to learn about their specific advocacy details, current or future projects, and the climate of biking in Worcester.

Worcester Earn-a-Bike

Worcester Earn-a-Bike is a non-profit organization that allows volunteers to repair or build bicycles at no cost, usually to benefit the Worcester community. We sought to learn about their previous work with Worcester university bike shares, the climate of biking in the city, and what things (if anything) that they advocate for.

3.3 Assess Current and Future Bikeability to Identify Benefits and Challenges of a Bike Share on the WPI Campus

In order to develop a plan for a bike sharing program that will benefit the WPI community, we gathered input and information from stakeholders across the campus. These stakeholders are divided into three categories: administrative groups, student organizations, and other stakeholders. Each of these represents groups that could benefit from the use of a bicycle share program. As such, for each group we sought their input on what their group would like to see implemented on the user end. Below is a description of each group with our reasoning for speaking with them. We interviewed each stakeholder, and have attached the transcripts as an appendix to this document in Appendix section B.3 Questions for WPI Stakeholders.

Administrative Offices and Divisions

WPI Department of Facilities

WPI Facilities is the department in charge of installing and maintaining infrastructure as well as managing buildings on the WPI campus. They could have an idea on workshop/storage locations on campus. We gathered information on the current and future bikeability as well as available space on the WPI campus.

WPI Police Department

WPI Police is the main group in charge of campus safety. We sought to learn about bike safety and theft on campus. Additionally, we had found that in some example programs, bicycles abandoned on campus were donated to the program. We inquired whether WPI Police collects abandoned bikes, and if so, if they would be willing to donate them to a bike share program.

WPI Division of Human Resources

Human Resources is charged with hiring and aiding employees of WPI. One Human Resources initiative is the Healthy Herd which promotes health and well-being among employees. We wished to learn how a bike share aligns with the goals of Human Resources.

WPI Division of Student Affairs and Campus Life

This Division oversees student life and events on campus. Therefore, the input of this office is invaluable in understanding the how a bike share could affect student life at WPI.

WPI Office of Admissions

Admissions is involved in marketing the university to prospective students. We heard their opinions on bike sharing as a marketing tool. We also sought information on student and applicant interest in cycling, mechanical tinkering, and / or sustainability.

Residential Services

Residential Services is heavily involved in student life. We sought their insight in biking habits on campus, bike storage options, and potential bike workshop locations on campus.

Student Organizations

The Student Green Team

The Green Team is an on-campus student group dedicated to sustainability. We were interested in learning how their goals compare to the goals of a bike share and if they would be interested in operating a bike share.

The Fitness Club

This group is involved in fitness activities on campus. We sought input on how a bike share could affect fitness habits at WPI.

Student Government Association (SGA)

SGA is the governing body of undergraduate students at WPI. They make important decisions regarding clubs and organizations, especially with regard to funding. We sought to gauge their interest in funding long-term events, and their opinions on bike sharing among undergraduates.

Graduate Student Government (GSG)

GSG is the governing body of graduate students at WPI. Similar to SGA, we were looking for their interest in funding long-term events on campus and how a bike share would affect graduates.

Other Stakeholders

President's Task Force on Sustainability

We interviewed the co-chair of the President's Task Force on Sustainability. We sought his opinions on bike sharing at WPI and his insight on the university's view of sustainability.

WPI School of Business

We interviewed the interim dean of the School of Business and gathered information on whether business students may be interested in running a bike share and opinions of bike sharing from a business perspective.

3.4 Develop Implementation Plans for a Bicycle Share Program for the WPI Campus

We developed implementation plans for a bike share program through the culmination of information obtained from interviewees at other universities, in Worcester, and at WPI. These plans represent a culmination of the research completed. Each plan represents the application of successful aspects of university bike shares to the WPI campus.

CHAPTER 4: FINDINGS

This chapter is divided into five sections. The first section lists the benefits and challenges to a bike share at WPI. The second section describes what aspects of other university bike shares have been successful and unsuccessful, and what university bike share operators would like to change about their program. The third section characterizes the five types of bike shares that can be found at a university. The fourth section outlines the fourteen essential aspects of a university bike share. The fifth and sixth sections detail the current and future bikeability of the WPI campus and city of Worcester respectively.

4.1 Benefits and Challenges to a Bike Share at WPI

Decrease Single Occupancy Vehicle Use

As stated, the Cyr et al. report found a significant portion of WPI community members would change the way travel if a bike share were implemented at WPI. We quantified the number of car trips between the main campus and Gateway Park that would be saved with a bike share as over 4600 car trips over the course of an academic year, as seen in Figure 5.

561 People drive at least once per week
29% of these trips could be changed
Over 4600 car trips saved per academic year

Figure 5: Car trips between the main campus and Gateway Park saved if a bike share were implemented

This number represents the number of car trips just between the main campus and Gateway Park and does not take into account the trips saved to the many other locations we determined as places users will travel with a bike share. These other locations are described later in this section.

A decrease in vehicles on campus and on the streets would help make WPI a “greener,” more sustainable university. Additionally, fewer cars make it safer for pedestrians traveling in the area.

Reduce Strain on Campus Parking

If the number of people traveling via car between the main and lower campuses is reduced, the strain and need for campus parking will decrease.

Improve the Health of Students and Employees

Compared to people driving in a car, users of a bike share would get more exercise. According to the vice president of human resources at WPI, a bike share would align with the goals of the Healthy Herd, an initiative by Human Resources to promote health and wellness for employees. Members of the WPI Office of Admissions in particular see a bike share on campus as a

“gateway drug” to better fitness practices in that by using a bike share, users will also add other healthier habits.

Market WPI to Prospective Students and Employees

Due to the improved sustainability of WPI with a bike share, the Office of Admissions and Human Resources stated that a bike share would help them market WPI to prospective students and employees respectively.

Decrease the Number of Bikes in Residence Halls

Residential Services cited bikes stored in rooms in residence halls as a problem. Bikes in the room decrease free space in rooms and cause roommate conflicts. If a bike share were at WPI, it is likely that fewer students would bring and need to store their own personal bike.

Help Residential Services Market Faraday Hall to Students

Residential Services stated that there is a perception among students that Faraday Hall is far away from the main campus. Our contact stated that a bike share by Faraday Hall would help them to “sell” the space to students.

Biking is the Most Efficient Form of Travel Between the Main and Lower Campuses.

The Dean of Students cites travel convenience and time efficiency for travel during the day as a large motivator for bike travel, which provides fast, efficient transportation around campus. Graduates, faculty, and undergraduates with classes or offices in Gateway Park could get there much more quickly and efficiently than by walking or driving. Faraday Hall residents could save time travelling to the main campus and back.

When we informally asked WPI community members why they drive between campuses, most answered that they do it to save time. We analyzed four trips between the main and lower campuses as seen in Figure 6.

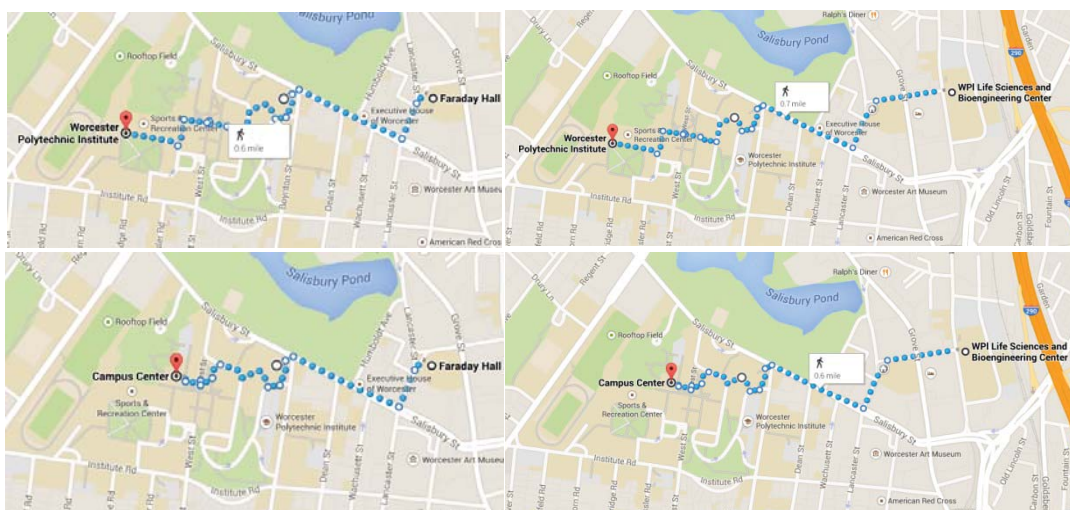


Figure 6: Trips analyzed via walking, biking, and driving. Clockwise from top left: Faraday Hall and the Sports and Recreation Center; Gateway Park and Sports and Recreation Center; Gateway Park and the Rubin Campus Center; Faraday Hall and the Rubin Campus Center

We recorded the total amount of time it took to walk, bike, and drive between these locations in both the uphill (east to west) and downhill (west to east) directions. The recorded time was the time it took to travel from the lobby of one building to the lobby of the other, so this included the time needed to unlock and lock a bike and the time to walk to and from a parked car. Times were recorded for walking, biking, and walking from the building to a parked car. The actual driving times was calculated using Google Maps at three different time points throughout the day to obtain an average time including traffic. Two of the most popular parking locations were analyzed for travelers to and from each of Faraday Hall and Gateway Park. The travel times for these trips are seen for Faraday Hall and Gateway Park in Figure 7.

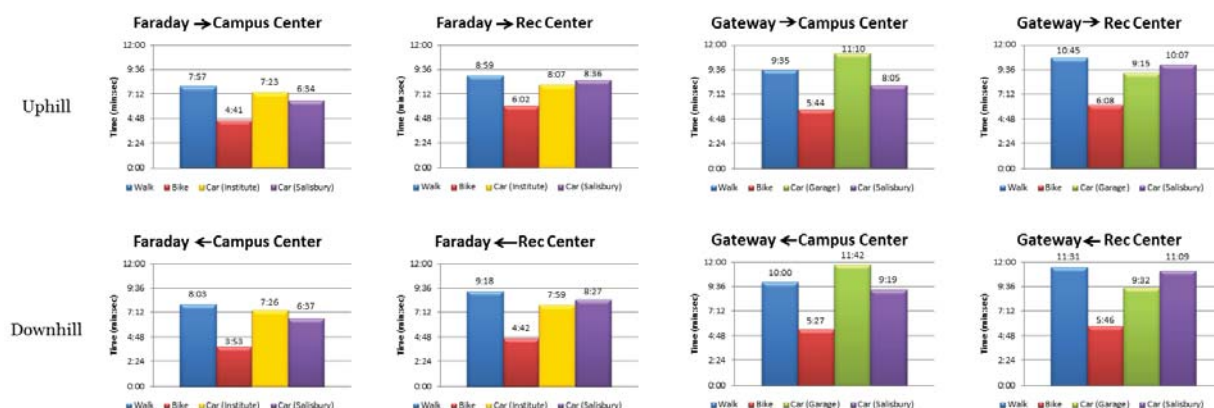


Figure 7: Travel times to and from Faraday Hall (left) and Gateway Park (right)

Of note, the trips between Gateway Park and the Campus Center via the Park Ave. Garage, it actually takes longer to drive than to walk.

Averaged across the eight trips, driving saves only 40 seconds over walking. Biking is the most efficient form of travel as it is 44% faster than walking and 40% faster than driving.

Users Are Likely To Use a Bike Share for 5 Different Reasons.

Inter-Campus Travel

As previously stated, bike share users are likely to use bikes for travel between the main and lower campuses, these trips are seen in Figure 8. According to Cyr et al, 50% of WPI community members go to Gateway Park at least occasionally, creating many opportunities for biking as a means of transportation. Travel amongst areas on the main campus would likely be limited due to the close proximity of buildings.

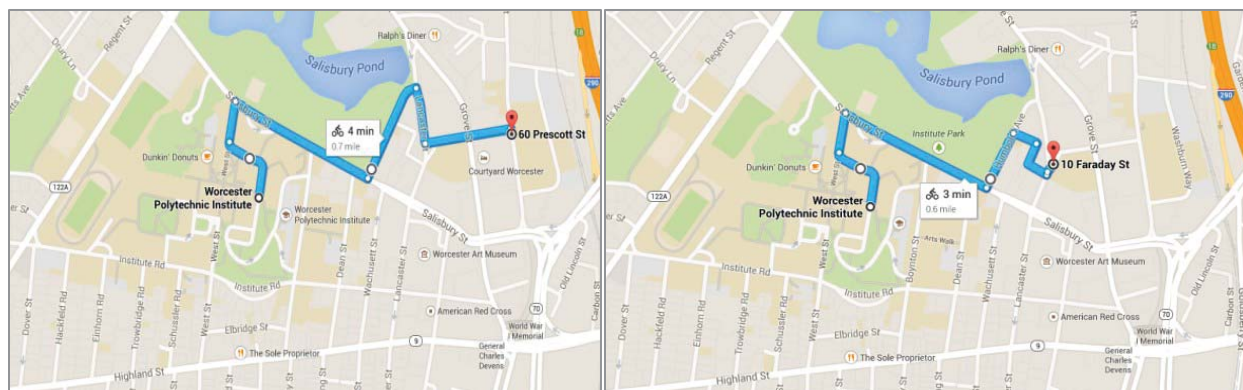


Figure 8: Bike route from library on the main campus to Gateway Park on the lower campus (left) and Bike route from library on the main campus to Faraday Hall, an upperclassmen residence hall (right)

Groceries, Shopping, and Restaurants

Many students at WPI do not have access to a car and therefore may have difficulty getting around the city. Students could benefit from a bike share by gaining easy access to destinations such as grocery stores, restaurants, and shopping centers. This is especially helpful to students living without a meal plan, as they need frequent access to groceries and food. Students and employees frequently visit restaurants during the day and evening as an alternative to dining locations on campus. Seen in Figure 9 is the average biking distance from campus to Price Chopper, a grocery store frequented by WPI students and the approximate center of Shrewsbury Street, an area with a high concentration of restaurants.

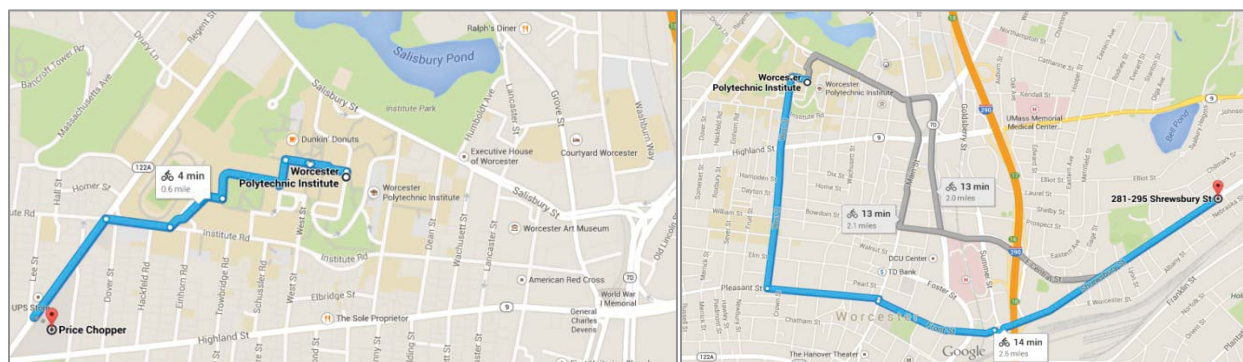


Figure 9: Bike route from library on the main campus to Price Chopper, a frequent route taken by WPI students (left) and bike route from the main campus to the approximate center of Shrewsbury Street (right).

There are many restaurants and shopping centers in the area around WPI as seen in Figure 10 with common destinations labeled. The red dots in the left map denote restaurants and the blue dots on the right denote shopping locations.

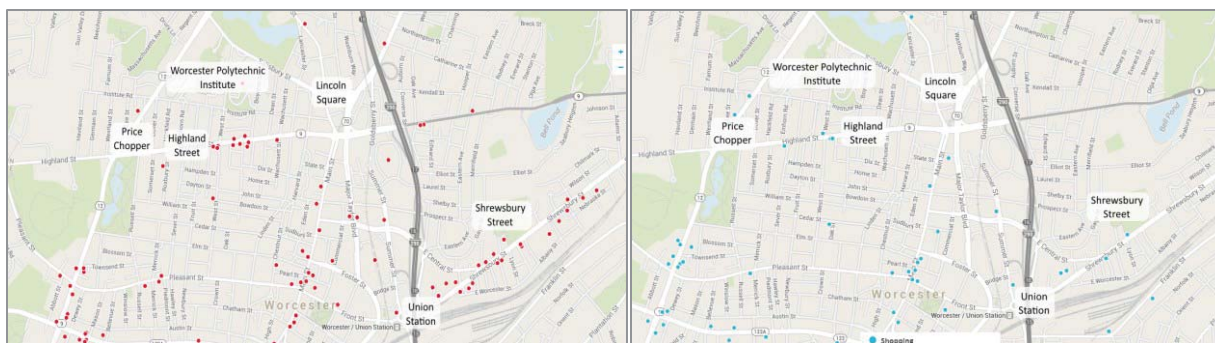


Figure 10: Maps showing restaurants in Worcester around the WPI area. Restaurants are denoted by red dots (left) and map showing shopping locations in Worcester around the WPI area. Shopping centers are denoted by blue dots (right) (Restaurants Map [Image]; Shopping Map [Image])

Jobs, Universities, and Destinations in the City

Bike share users are likely to use bike to get to jobs, other universities, and other destinations in the Worcester. Many upper-class students have jobs or internships and they often need fast, reliable transportation to get to those jobs. Additionally, both faculty and students sometimes need to get to other universities in Worcester, whether because they are taking a class there, or because they hold positions at multiple universities. Seen in Figure 11 is a bike route from WPI to Clark University. Worcester has many locations that students and employees may need access too. One such location is Union Station, Worcester's connection to the Massachusetts Bay Transit Authority (MBTA) and the central transportation hub for the city. Also in Figure 11 is the route between WPI and Union Station, a 10 minute bike ride.

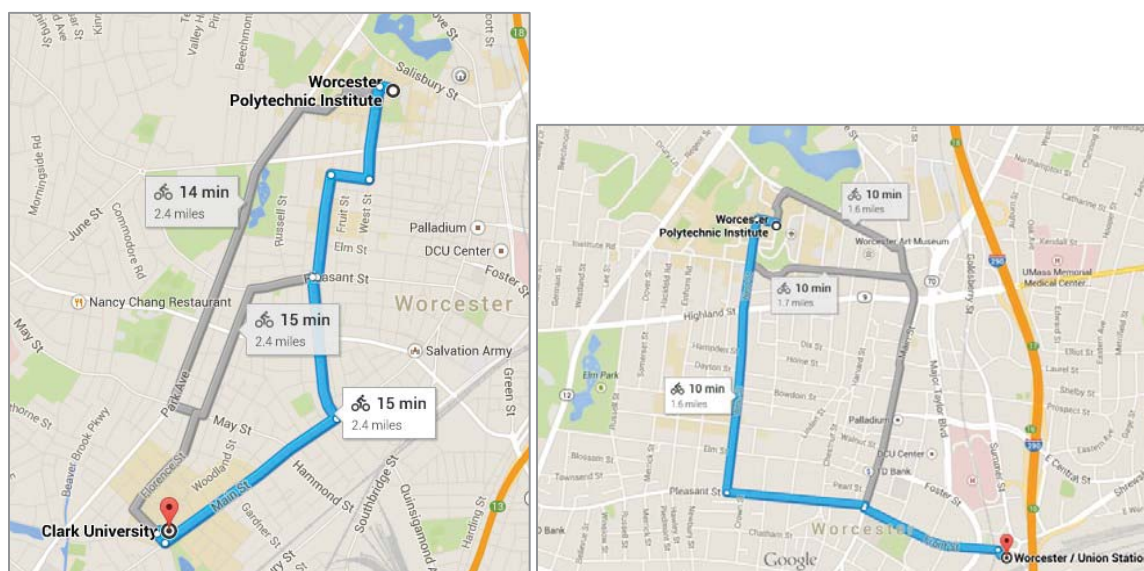


Figure 11: Maps showing the 15 minute bike ride from WPI to Clark University (left) and the 10 minute bike ride from WPI to Union Station (right)

Back and Forth from Off-Campus Apartments and Peripheral Residence Halls

Bike share users are likely to use as bike to get to off-campus apartments during the day. Commuting during the day is a major aspect of transportation in and around the WPI campus.

In our interviews, students expressed interest in riding bikes to these locations during the day to eat or change clothes. Seen in Figure 12 is the approximate distance and travel time between the main campus and Salisbury Estates, one housing complex that students live in.

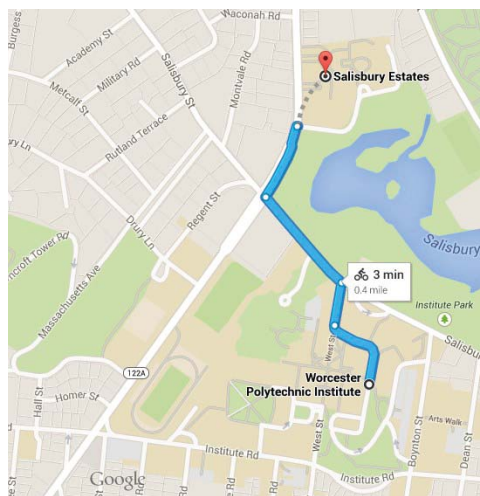


Figure 12: Map showing the bike ride from WPI to Salisbury Estates

Exercise and Leisure

Bike share users are likely to use bikes for exercise and leisure. Many WPI community members make use of the Sports and Recreation Center or exercise in other ways. The Fitness Club at WPI has identified WPI students as a group focused on health and fitness. Faculty and staff visit the Sports and Recreation Center as well, often during their lunch break. The stationary bikes in particular are a popular exercise machine, and gym users are sometimes left waiting for an exercise bike to open up. A bike share would allow the same kind of workout, but in a more dynamic, interactive way, while also freeing up demand in the gym. Seen in Figure 13 is an example route one could take to downtown Worcester.

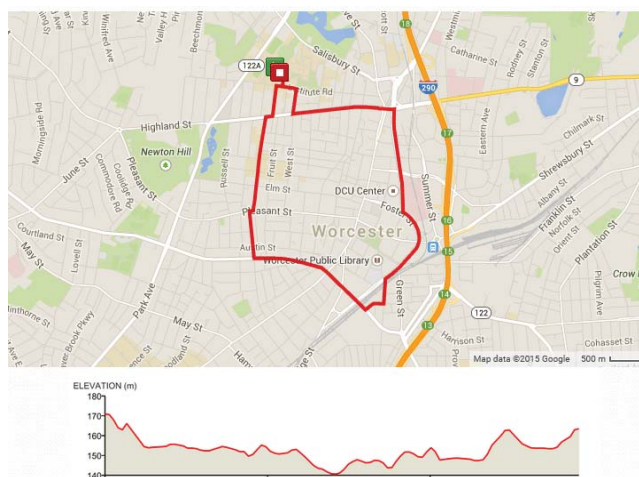


Figure 13: Potential biking route to downtown Worcester 3.6 miles.

Challenges to Implementation of a Bike Share at WPI Exist.

Natural Conditions

There are many hills in Worcester, including in the area around WPI. Hills can be a challenge to casual bikers. Also, Worcester receives significant snow accumulation in the winter. These two challenges do not necessarily inhibit a bike share from being successful. There are over 150 university bike shares in the country, many in the northeast, and two others in Worcester. Most university bike shares in the region close for the winter sometime in December or whenever the first snow and ice occur. They usually open in March once most snow and ice has melted. At WPI, this would result in the bike share being closed only in C term from January partially through March.

Perceived Lack of Bike Infrastructure in Worcester

Among interviewees it is perceived that there is a lack of bike infrastructure.

Bad Habits Among Drivers and Bicyclists

It was noted by representatives from bike advocacy groups that both drivers and bicyclists have bad habits and do not follow all the rules of the road.

Bike Theft

Interviewees at WPI commented that bike theft is prevalent at WPI. When discussing this problem with the WPI Campus Police, it was stated that most bikes that are stolen have cable locks as opposed to more secure u-locks.

Though these challenges cannot be entirely overcome, the latter three challenges can be minimized by proper user education. Most university bike shares have an educational component when users sign up. This education commonly includes descriptions of the safest paths for bikes to take around the city, laws regarding bicyclists on the road as well as bicyclist rights, and safest way to lock a bike.

4.2 University Bike Shares

These findings are derived from bike share programs at seven colleges: Worcester State University, Clark University, New York University, Rochester Institute of Technology, Skidmore College, Tufts University, and Wellesley College.

Successful Elements of University Bike Shares

The responses regarding successes can be grouped into a few loosely-related categories as seen in Table 2.

Table 2: Successful elements of case study university bike shares

	Successful elements	School
Bike Use	Bikes used as alternative to driving or taking a shuttle	WSU
	Bikes used to travel off campus	WSU, CU
	Users feel accountable and responsible for bikes	NYU
	Variety of bike types, students choose a bike that is "theirs"	NYU
Program Expansion	Donor found out about program and donated large sum of money to expand program. 5 new bikes and an awning to protect bikes were added.	WSU
	High, consistent demand	RIT, SU
	Program is scalable, can add bikes and racks if program is successful	SU
Maintenance	Maintenance plan - Cycling club is paid every week to maintain bikes for set number of hours	RIT
	Bike shop to store tools and fix bikes. Essential for the bike share	RIT
Benefits	High visibility sustainability initiative	SU
	Highlight for campus tours	SU
	Allows people to get involved in sustainability in fun way	SU
	High awareness of bike share due to branding and marketing	TU

Miscellaneous	Bike use data can be collected and analyzed	SU
	Bike Corral checkout from Residential Life office has worked well	TU
	Anybody at the college is allowed to use the program	WC
	Program is good for student life	WC

Key: WSU = Worcester State University, CU = Clark University, NYU = New York University, RIT = Rochester Institute of Technology, SU = Skidmore College, TU = Tufts University, WC = Wellesley College

Unsuccessful Elements and Desired Improvements of University Bike Shares

Almost all of the responses can be categorized into six different groups: user education, bike type, operator numbers, expansion, maintenance, and logistics as seen in Table 3.

Table 3: Unsuccessful elements and desired improvements of university bike shares

	Unsuccessful Elements / Elements to Improve	School
User Education	Students return key without bike in proper place	RIT, WC
	Students don't know how to use locks	WSU, WC
	Users not returning bikes to proper spot	SU
Bike Type	Bike type: Heavy, only foot brakes	NYU
	Bikes low quality: break down often	TU
	Bikes' pedals often break	RIT
	Bikes not initially street legal	RIT
Operator Numbers	Too few people operating the bike share	WSU, WC
	Sustaining membership to operate / maintain bike share	CU, TU
Expansion	Add another bike location / bike count	RIT, SU
	Add more bike share operators	SU

Maintenance	No initial bike repair infrastructure	WSU
	Half of all bikes offline during maintenance	RIT
	Wish to compensate student mechanics for work	TU
Logistics	Desire an automated system	CU, RIT, SU
	No initial winter storage plan	RIT
	Working out logistics charging student accounts for fines	RIT
	Subpar analytics	NYU
	Problem reporting system not ideal	NYU
	Better helmet rental / distribution: currently at different location than bikes	SU
	Key distribution “Keywatcher” system does not work well	WC
	Limited marketing	NYU

Key: WSU = Worcester State University, CU = Clark University, NYU = New York University, RIT = Rochester Institute of Technology, SU = Skidmore College, TU = Tufts University, WC = Wellesley College

The biggest advantage of automation is the ability to distribute bikes any time of day or night as opposed to the bike share being tied to the staffed hours of a campus building. With regards to maintenance, Worcester State University did not begin their program with space for a bike repair shop. When a bike broke down, the facilities to repair the bike were not available.

[Bike Shares Are Typically Open to All University Community Members.](#)

Students may make up the bulk of the users, but faculty and staff make use of the share too. All of these groups use these bikes for transportation, exercise, and leisure. Each of the case study programs allows all members of their campus community to use the share, though they are usually most popular among students. This inclusiveness could also allow all members of the university community to engage with each other in a common activity, creating relationships between faculty and students, graduates and undergraduates, or students and staff.

[Successful Bike Shares Are Organized by Strong and Active Leaders or Groups.](#)

The most successful bike share programs are run student volunteer groups that are passionate about biking and the ideals of bicycle sharing. Students generally have more time to dedicate to a bike organization on a day-to-day basis than a university employee. Students in these

programs are in charge of managing the program day-to-day, which involves organizing checkout procedures, performing maintenance checks, maintaining the bikes when needed, and maintaining records of bike share members. Students also organize marketing and communication to campus, such as residence hall programs, flyers, information sessions, and safety training. Having one central group in charge of the program gives that group a sense of responsibility and ownership of the share. Due to the transient nature of college, however, student interest in the program can fluctuate. Marketing and recruitment activities are important to maintain a relatively faithful pool of share members. Having an active faculty or staff advisor could help students achieve goals and help maintain continuity of leadership in the long term. A faculty or staff advisor would be able to be involved for a longer period than any given student and can aid in transition periods between student leaderships, helping to keep the club in existence when older students leave. They can also keep students motivated to run the share if interest is starting to fade.

Another option in terms of organizational group is having the program run by an administrative group, commonly working out of the universities' sustainability office. The advantages of this approach are heavy faculty and staff oversight and having the share incorporated into the institution. In this way, the program receives its funding from the administrative office's budget, creating a steady flow of funding for the program. This means, however, the share budget is limited to how much the office is able to spend on the program. Also, this approach does not allow for much student involvement, which has been identified by the interviewees as important in creating a bike share. Wellesley College runs their program through their Office of Sustainability, where they hire a part-time intern to manage the share. They have found that an intern may not necessarily be passionate about the program, however, leading to management issues. Skidmore College has a similar approach, where they hire a Bike Manager. They have found that the work involved in maintaining all aspects of the share is more than one person can handle. Overall, bike share operators without a student group have expressed dissatisfaction and most desire more involvement among students.

Proper Equipment and Facilities Are Required to Maintain Bikes in a Bike Share.

Tools & Materials

Tools and materials such as replacement parts are necessary for programs that require members of the university conduct repairs and care for the bikes. According to many operators of our case study programs, some bikes need servicing fairly often, usually for small issues like loose chains and flat tires, but major repairs are sometimes necessary.

Bike Workshop

A bike shop is a place to store bikes and tools, repair bikes, store bikes when not in use, and to potentially hold share meetings or events. This space does not need to be big, just large enough to house the bikes, tools, and parts in the share. At Clark University, members use a former janitorial closet in the basement of a residence hall for repair and storage. Worcester State, on

the other hand did not have any such repair infrastructure in place for their first semester of operation, and they identified this as a problem to be resolved going forward.

Log System

A log system is designed to record the condition of bikes, whether they are checked out, at a rack, in the shop, or under repair, etc.. A log system could either be on paper where users and share members keep them updated by hand or on a computer. A computer system would be much more convenient for keeping the bikes in order. This could take many forms, such a system where users input directly into a computer or one where users simply swipe their ID cards to receive a key. Computer systems for tracking bike patterns are supplied by the automated bike share companies.

Locks

Successful programs allow users to park and lock bikes wherever they want during the allotted checkout period, as long as the bike is returned on time. U-locks are made of solid steel and are very resistant to damage and theft. Almost all case study university bike shares provided U-locks with the bikes so they could be parked and locked at any location.

The Length of Time Users Can Take Out a Bike Depends on the Type of Bike Share and the Goals of the Program.

Figure 14 displays checkout times at case study universities. In some programs, the checkout period of bikes is limited to the building hours of the checkout location. In order to return a bike on time the user must return the key before the building closes. Other programs required the bikes be returned after a set time period. A long checkout time such as 24 hours encourages users to use a bike throughout an entire day whereas a short checkout time such as 5 hours encourages users to use a bike as needed for a trip or two and then return it for others to use.

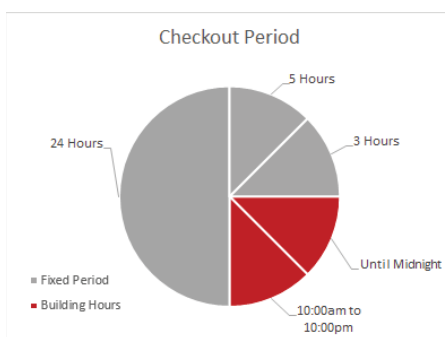
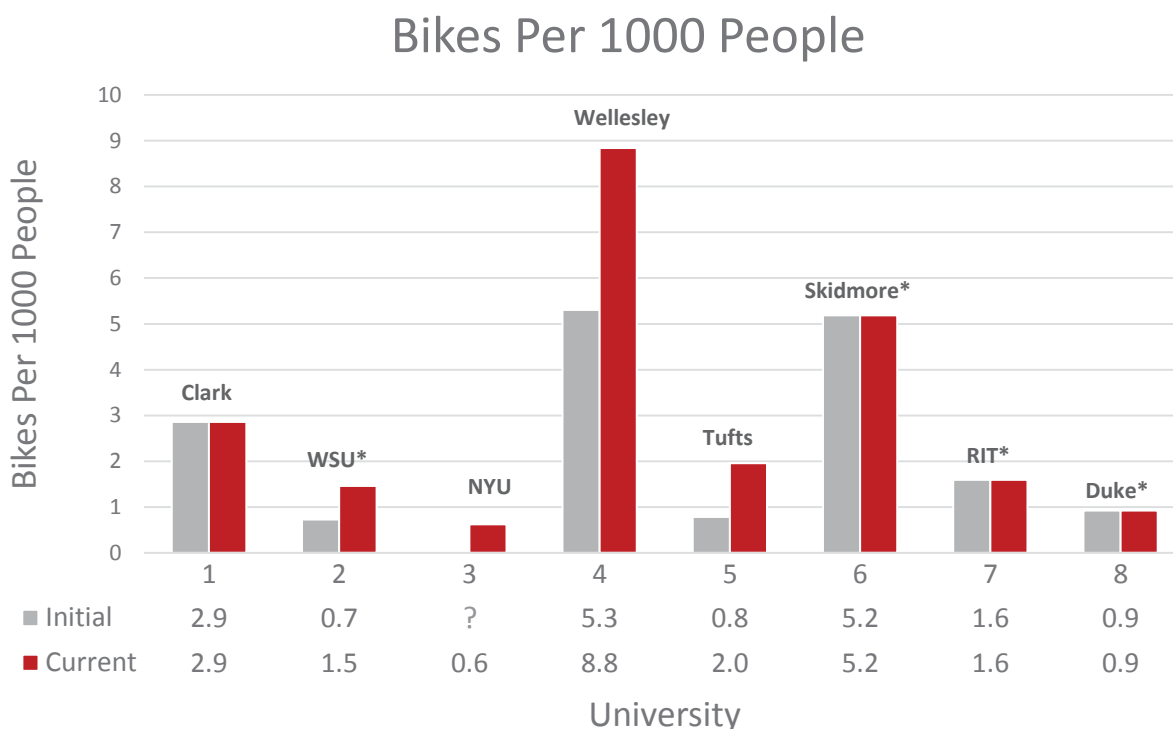


Figure 14: Checkout period at various example universities

The Due To Increasing Demand, Bike Shares Typically Increase the Number of Bikes in the Program of Time.

Figure 15 depicts the number of bikes per 1000 people at each of the case study universities, both in terms of the number of bikes with which the program started and the number to which the programs expanded. There is some variation between schools, due mainly to differences in population and program funding. New York University, for example, has a total population of nearly 73,000 people; it is under represented in bicycles despite having the largest number of bikes we have encountered at a program at 45 bikes. Contrarily, Wellesley College has 25 bikes to support a total population of about 2,800 people. The average number of bikes that each university started out with was around 2.5 bikes per 1000 people. Over time, many of these programs expanded to meet increased demand. The average number of bikes currently in each program that has expanded is 4.1 bikes per 1000 people. To note, Worcester State University, Skidmore College, Rochester Institute of Technology, and Duke University implemented their bike share within the last two years and may expand in the near future.



* = Implemented in last 1-2 years

? = Unknown value

Figure 15: Number of bikes per 1000 people at case study university bike shares.

4.3 The Five Types of Bike Shares

Each university bike share system has advantages and disadvantages and each operates using different procedures. These systems include the ad hoc, bike corral, kiosk, automated key box, and technology-on-bike systems (“Bike Share Implementation Strategies: A Comparative Guide, 2013).

Ad Hoc

An ad hoc system is the simplest form of bike share. On a college campus, bikes are placed unlocked throughout and are free for all to use. Users pick up a bike, ride to another location, and then leave the bike for the next person to use.

The advantages of an ad hoc system are its low cost, the only purchase is for the bikes, and it requires little to no management.

There are many more disadvantages to this system. In a location with prevalence of bike thefts since these bikes are not locked, they would likely be quickly stolen. In addition, there is little to no user accountability to maintain the bikes, and the bikes’ locations are not predictable. Finally, there are liability and safety issues since the bikes are not maintained or checked to ensure bike safety. We did not find any universities that use the ad hoc system.

Bike Corral

The second system is termed a bike corral where bikes are distributed from one or more central locations. Bikes are signed out in person and there is little to no automation. This is a common system used on college campuses, although to note, some schools are moving away from bike corrals for reasons explained in a later section. In a typical bike corral system, bikes are located near a location with a permanent staff member. This staff member need not be the same at all times, but one must be present. Common locations on campuses for a bike corral are a library, student center, residence hall, or any other building with a desk manned by an employee during building hours. Users go to this employee and enter their contact information into a log book to receive a key to a bike.

The advantages of a bike corral are a relatively low start-up cost, centralized management and operation, and the ability to take bikes off campus. The initial investment is mainly in the bicycles, racks, locks, and helmets and little technology is required. The program is managed from one location and all interactions with users occur at this location. Because users receive the key to the lock on the bike, they can take that bike to another location on or off campus. The lock allows the user to safely leave the bike.

The main disadvantages of a bike corral system are restricted checkout time and limited location availability. Checkout time is restricted and a 24-hour operation is not possible because a bike corral is tied to the hours a staff member is working at the bike corral location. For example, if the student center opens at 8am, then bikes cannot be checked out

until at least that time. The location of the bike corral is limited for a similar reason, in that a bike corral can only be established at a location with a working staff member. If a campus contains locations such as at peripheral residence halls, academic buildings and research laboratories, or parking garages at which users could benefit from access to bikes, without a dedicated staff member a bike corral is not feasible at these locations.

The bike corral seems to be the most common university bike share system. Examples of universities in this report currently with bike corral systems include Worcester State University, Clark University, New York University, Rochester Institute of Technology, and Tufts University.

Kiosk

Another bike share system is the kiosk-based system at which bikes are located at designated bike stations or hubs. The kiosk system is automated and the bikes lock directly into the hub via locks built into the specialized infrastructure. A user typically swipes a credit, debit card or other ID and then selects the number of the desired bike using an electronic keypad. The selected bike is automatically unlocked from the hub and ready for use. The bike does not come with an additional lock so can only be left at a hub. As a result, hubs must be built and placed at the locations bike users are likely to go.

The advantages of the kiosk system are high security, 24 hour access, and an automated system to track bike use. The infrastructure is rugged and secure and it would be difficult for a bike to be stolen from a hub. Because the system is automated, bikes can be accessed up to 24 hours per day. It is also possible to collect real-time data on bike use based on the electronic sign-out of each bike.

The main disadvantages of this system include the high start-up infrastructure cost and limited bike travel locations. The infrastructure for a kiosk system is more extensive and expensive than any of the other four bike share systems. A Hubway station with 15 bikes costs about \$40,000 (Laguarda, 2015). For this system to be effective however, two or more stations must be constructed around a campus. Because bikes can only be locked at a station, they cannot be ridden and left behind at any other location. This would prevent the bikes from being used for grocery shopping, running errands, going to restaurants, a train station, or another university.

The kiosk system is more common in cities than at universities. Though there are many examples of cities using the kiosk system, such as New York City's Citi Bike and Boston's Hubway, we did not find any universities that use this system.

Automated Key Boxes

The automated key box system is an automated system with the electronic key boxes mounted directly on the bike racks. This system is provided by the company On Bike Share, based in Bristol, Rhode Island. One key box exists for each bike in the share. The user uses a personal identification number (PIN) to open the key box for a desired bike. The key inside the box is used to unlock an integrated U-lock on that specific bike. The user can use the bike for a predetermined amount of time and due to the integrated U-lock, it can be locked at any

location. Upon returning the bike, the user again uses a PIN to open the key box and inserts the key. Every time the door to the key box is opened, the name of the user information, date, and time are recorded. The key boxes come installed on custom racks and because they are battery powered: no electrical nor internet infrastructure is required. A bike station can be installed anywhere with flat ground, just as with any bike rack.

There are two different versions of the management software for this system: PC-based and web-based.

In a PC-based management system using the provided software, the bike share operator randomly generates a set number of PINs which is then uploaded onto each key box. One of these PINs is assigned to each user when he or she signs up for the program. The user then uses this PIN to open a key box, either to sign out or check in a bike.

In a web-based management system, the bike share operator uploads a unique set of PINs to each key box. To sign out a bike, the user uses a smartphone application (app) to select the desired bike and to receive a one-time-use PIN to obtain the key from the key box. Upon checking the bike back in, the user again uses the app to obtain a one-time-use PIN to return the key to the key box. As with the PC-based management system, the user information, date, and time are recorded, but with the Web-based system, the data is recorded using the application as opposed to the key box itself. As a result, this data is obtained in real time.

The main advantages of an automated key box system are the options for bike station locations, ease of use, data collection, and security. As opposed to a bike corral system, automated key box bike stations are not constrained to locations with staff nearby. Once set up, the system is automated and requires not managers to be present. The stations are also modular in that any number of bikes could be set up in any given place. This system is easy to use. In a PC-based system, the user has an assigned PIN and simply inputs that PIN to a key box with a corresponding bike. In a web-based system, the user simply uses a smartphone application to generate the PIN to open the key box. Data collection makes it easier for the bike share operator to manage the system, and to track down individuals if any damage occurs to a bike or a key goes missing. Finally this system is secure in that any time a key box is opened, the user's information is stored, the integrated U-lock allows the bike to be safely locked when the user leaves it, and once in use, the key cannot be removed from the lock until the lock is in place. So, even if a key was stolen, the bike itself would be locked and unable to be used.

The main disadvantages of an automated key box system are a higher start-up cost when compared to a bike corral, issues with proper return of bikes, and some additional management. This system requires some additional technology, including the key boxes, specialized bike racks, and specialized bikes, so it will have a higher start-up cost than some bike corrals. One possible issue with returning bikes can occur in the PC-based system. Even though each bike should be returned to the same location from which it was signed out, since a

user has access to all key boxes, it is possible for the user to return a bike to the wrong location. This makes it more difficult for tracking users and bikes with the management software. To note, the web-based system does not have this problem because the app will only allow the user to return the bike to the correct key box. Finally, in the PC-based system, operators must individually upload the randomly generated PINs to each key box via a USB. This upload takes place when starting the bike share, and any time more members join beyond the number of initially generated PINs. To obtain the usage data, this information must be individually downloaded via USB as well. To note, the web-based system does not have this problem because data is collected through the app. In the web-based system, the operator must upload new random PINs to each box every three to four months.

Examples of universities in this report currently with the On Bike Share automated key box system Skidmore College, and Wellesley College, though Wellesley uses an alternative key sign-out method.

Tech-on-Bike

This system is fully automated but as opposed to the key technology being housed in additional infrastructure or on the bike rack, it is located directly on the bikes. Two companies that provide tech-on-bike systems are Social Bicycles and Zagster which will be examined in this section. Zagster is based in Cambridge, Massachusetts and provides bike share equipment as well as bike share planning and maintenance services. Zagster works with each university to create a specialized bike share for that university. A user receives a PIN to sign out a bike via text, online or with the Zagster app. The PIN is then used to open a key box located on the back of the bike above the rear wheel. The key unlocks a standard u-lock which is paired with the bike. Thus, the bike can be ridden to any location and locked safely. The checkout format for a tech-on-bike system with Zagster can be station-to-station like a Kiosk system or ride-and-return. A bike can be signed out at any station and signed back in at any designated Zagster station. Checkout time, checkout format, and membership fees are determined by the university and Zagster. Zagster designs, builds, and operates the bike share. They help determine the ideal distribution of bikes on campus and set up promotional groundwork for a launch of the program. Mechanics then install all of the equipment and bikes and then continue to maintain the bike fleet. The university pays a flat annual fee per bike in the system.

The advantages of the tech-on-bike system by Zagster are ease of use, convenient start-up and maintenance, and encouraged multi-user bikes. First, it is very easy for a user to sign out and use a bike because the bikes can be reserved three different ways, via text, online, or with an app. Zagster provides all installation and maintenance services so the facilities department does not need to install any infrastructure and student groups or employees do not need to maintain the bikes. Finally, the station-to-station checkout format with a 3-hour free limit encourages users to sign back in the bikes relatively quickly, freeing those bikes to be used by more people.

The disadvantages of the tech-on-bike system are the potential need to rebalance the bikes and the higher cost. If the checkout format is station-to-station and a riding preference among users exists from one given station to another, the bikes could become distributed unevenly. If this occurs, the bikes must be rebalanced by the bike share operators. This scenario can occur if a hill exists between two stations as users may prefer to ride down the hill but take another form of transportation up. Additionally, the annual cost for this system is more than the bike corral or automated key box systems.

Examples of universities with a tech-on-bike system with Zagster include Duke University, Yale University, and California State University East Bay.

Due to Problems and Complications With Bike Corral Systems, Some Schools Have Switched to Automated Bike Share Systems.

Switching from a bike corral to an automated system was due to the fact that the bike shares had problems that put a strain on the university. The Skidmore College bike corral system had difficulties with bike checkout procedures where users signed out bikes at the library. Because so many different employees worked at the library desk, there was much inconsistency in both the procedures for signing out bikes and reporting problems. At Duke University, the administration shut down the program because of decreased use and the liability risk for the university. Use declined because the building at which the bike corral was originally located went under renovations and the bike share moved to a location less visible and known to potential users. Liability became a problem due to the use of repurposed bikes which are more difficult to maintain quickly than new bikes or bikes designed specifically for bike shares.

As a result of these problems, Skidmore and Duke switched to an automated bike share, automated key box and tech-on-bike systems respectively. The checkout procedures for these systems solved the problems they had. They purchased bike share designed bicycles which reduced maintenance and safety concerns. The Clark University bike share has also expressed interest in switching or integrating an automated system for bike checkout to reduce the work involved in bike check-out and sign-in.

4.4 Fourteen Essential Aspects of a University Bike Share

Based on our research of the different types of bike share systems and specific programs at other universities we developed a list of the fourteen essential aspects of a university bike share. An essential aspect is a variable that must have an answer or a plan before a bike share can be successfully established. When implementing a bike share, each of these must be addressed. Below is an explanation why each aspect must be addressed as well as some common examples of solutions.

1. Bike Share System

How will the bike share be organized? What will it look like? Before focusing on any subsequent details, it must be decided how the overall system is going to be organized. Once it is decided what bike share system is desired, many of the other variables fall into place. However, the issue in deciding which bike share system to use is one must take into account all of the variables for each system. As described earlier in this Findings chapter, we found there are five types of possible university bike share systems: ad hoc, bike corral, kiosk, automated key boxes, and tech-on-bike.

2. Bike Sign Out / Log Method

How will users sign out a bike? How will data on bike use and maintenance needs be collected? A procedure must be established for bike, helmet, and lock sign-out and distribution. This can be done manually at an information desk or automatically. In addition, a system must be in place to keep record of at least the following: whether a bike is checked in or out, if a bike is in the shop under repair, what condition the bike is in, and how long a user has had a bike.

3. Bike Locations (number and placement)

How many bike share stations will you have? Where will these stations be? With the exception of an Ad Hoc system, a bike share should be centralized at one or more locations. The station should be at a location where users will most likely find themselves in need of a bike. Sometimes stations are at peripheral locations such as parking garages or residence halls. This enables users to begin on the periphery of campus and move efficiently to the center. On the other hand, bike stations are also useful at a central location where there is a high concentration of users. From this point, many users can take a bike and ride off to a destination in many directions.

Other factors to consider include uniqueness of bikes in the share, protection from traffic and weather, and security. The decision on where to place a bike share station takes into account these factors. Users should be able to distinguish bicycles of the bike share from other bicycles on campus. In addition, the placement of one or more stations must be decided based on aspects such as concentration of students nearby, pedestrian and vehicular traffic passing by, and the availability of protection from weather. Finally, the bikes should be secure at this location.

4. Bike Locks

Should users be given locks with the bikes? If so, what kind of lock should they receive? With the exception of the ad hoc system, locks are essential and used to minimize the chance of theft. Whether or not students should be given locks depends on the bike share system. In a kiosk system, the goal is for users to ride the bikes from one station to the other, never leaving the bike at a place other than another station. In this case, no additional lock is required. However, if the goal of the bike share is to allow the users to ride and leave the bike at a location other than a station, the user should be provided with a lock to avoid bikes being left unlocked. Based on a discussion with a member of the WPI Police, the bikes that are most

likely to be targets of theft are those at racks that are heavily used and those with cable locks. Because of their effectiveness, the WPI Police have even considered purchasing U-locks and selling them to bicycle users at a discount to encourage their use.

5. Bike Type

What type of bike should be used? Each type of bike has advantages and disadvantages and the goals, geographical location, and maintenance abilities of the share will help determine the proper bike type. In the ad hoc and bike corral systems, the type of bike is variable. In some cases, such as NYU and Tufts, purchasing new bikes is one of the start-up costs of the program. However, the Clark and Worcester State bike shares got used bikes at a considerably lower price (in the case of these two schools, free). These bikes are varied and unique, but can present maintenance challenges with non-standard parts and pre-existing wear. This is contrasted with bikes that come directly from bike share companies such as On Bike Share and Zagster. With these two companies, the bikes they supply are internal-gear, touring-style bikes, usually with front or rear baskets. The gearing on these bikes can be adjusted to match the geographical characteristics of the university / city they are used in, but provide a limited set of gears for the user. The proper type of bike must be determined in starting a bike share.

6. Number of Bikes

How many bikes should including when implementing a bike share? A proper initial number of bikes when implementing a bike share must be determined. As seen in Figure 15, of the case study schools in this report, university bike shares began with an average of 2.9 bikes per 1000 people. This number is often increased if the program is deemed successful and additional demand exists. Schools that have expanded their programs have a current average of 4.1 bikes per 1000 people.

7. Bike Share Operator(s)

Who will be in charge of the program? Who will perform daily or weekly tasks? With the exception of an Ad Hoc program, a bike share must be organized and operated by an individual or group. Operator responsibilities include marketing, branding, signing out bikes, tracking bike use, checking on the condition of bikes, maintaining the bikes, and enforcing bike share rules. Common bike share operators include members of a school's sustainability office, student organizations, and outside companies.

8. Bike Share Users

Who will be allowed to use the bike share? Potential users of a university bike share include faculty, staff, undergraduate students, graduate students, and summer guests on campus. Often, a user must be 18 years or older to be able to sign a liability waiver.

9. Checkout Time

How long will users be allowed to ride bike before it must be returned or locked at another station? There are opposing factors to consider about checkout time. If users are allowed to have bike for longer periods of time, they may treat the bike as their own. The individual bike

will not be used often and may be locked and out of use for long periods of time. On the other hand, if users are too limited with time, they may be discouraged from riding longer distances away from the campus. It could discourage recreational rides, trips into town or the city, riding to the train station, or running errands away from campus.

10. Checkout Format

After signing out a bike, where does the user sign it back in? There are two main formats for a bike share: so called ride-and-return and station-to-station. In a ride-and-return format, the user must return the bike to the same station or even same rack from which it was signed out. In a station-to-station format, a user can sign in the bike at any station within the bike share. One problem of station-to-station bike share systems is bike rebalancing. This is needed if bikes tend to accumulate at one station. If there are too many bikes at a station, there may not be enough space for another user to sign in a bike. If there are too few bikes at a station, there may not be a bike available for a user to sign out. Ride-and-return systems do not have this problem because the bike is always returned to the same spot from it was signed out. Another checkout format issue is the required checkout time which goes hand in hand with checkout format. In a station-to-station format, on a commute from one campus station to another, the bike is signed out and back in to another station in a matter of minutes. In a ride-and-return format, the checkout time must be long enough that the user who uses it to commute is able to do whatever he or she needs before returning the bike. Thus the checkout time for ride-and-return tends to be longer than for station-to-station.

Table 4: Comparison between Ride-and-Return and Station-to-Station systems

	Ride-and-Return	Station-to-Station
Advantages	<ul style="list-style-type: none"> • No need for bike rebalancing 	<ul style="list-style-type: none"> • Shorter checkout times
Disadvantages	<ul style="list-style-type: none"> • Longer checkout times 	<ul style="list-style-type: none"> • Potential need for bike rebalancing

11. Cost to User

How much should the user pay for use of the bike share? If a goal of the bike share is to break even or earn back the initial investment, then a charge for use of the bike share makes sense. If a goal of the bike share is to increase bike use as much as possible, promote a bike friendly culture, or maximize replacement of unsustainable transportation methods, a cost may be hinder these goals.

12. Workshop Space and Maintenance

Where will the bikes be maintained? Bikes inevitably need to be tuned up and maintained. Some maintenance and daily checkups can take place at the bike station. A portable pump and set of wrenches or a bike fix-it station would provide the tools for simple maintenance issues

such as filling tires and tightening bolts. However, more in depth maintenance requires both the workshop space and additional tools.

13. Winter Storage Space

Where should the bikes be put in the winter? In northern regions of the country, specifically in New England, most bike shares close for the winter due to the snow, ice, and low temperatures. To preserve the bikes for as long as possible, they should be stored inside, or at least protected from the weather / corrosives used on the road.

14. User Sign-Up, Liability, & Education

How will users sign up for the bike share? What liability will there be if a user is injured while riding one of the bikes? How will users know how to ride the bike safely? It is important for users to understand how the bike share is run. Users must know the procedures of share such as how to sign out and sign in a bike, how to report a problem, where they can ride, and how to lock the bike. Additionally knowledge of bike safety, rules of the road, rights of bicyclists, and a basic knowledge of maintenance are required to increase the safety of users. In terms of liability, most programs have a liability waiver in which users agree to ride at their own risk.

4.5 Current and Future Bikeability of the Worcester Polytechnic Institute campus.

Conditions at WPI Appear to Support a Bike Share.

Students, faculty, and staff seem to be very aware of sustainability issues and are actively engaged in making sustainable change on campus. This is evidenced by the presence of the President's Sustainability Task Force, the Student Green Team, and the WPI Facilities Department's commitment to sustainable practice. Similarly, the Fitness Club suggests that students are very interested in fitness options on campus. Many students are not allowed to drive while at school; freshmen, for example, cannot have cars on campus, and international students may not be able to drive in the United States.

The Dean of Students' notion of the "time economy" suggests a motivator for the fast, efficient transportation method of biking. Seven week terms make time at WPI a valuable resource, and people are eager to save it wherever they can. The presence of the lower campus separated by a few city blocks presents a very strong need for transportation during the school day. Students at WPI are young and healthy, and enjoy getting outdoors with a bike.

There is Sufficient Infrastructure to Support Growth in Bicycle Use on the WPI Campus.

Maps of the WPI campus, Figure 16 and Figure 17 were created showing the placement of bike racks. Figure 16 depicts the locations of racks on the main campus and Figure 17 depicts the location of racks on the lower campus. Over the previous years, it has been a conscious effort of the Facilities Department to add in bike racks when possible. When new buildings are built or when areas such as the quad are renovated, additional racks have been added.

As seen in Figure 16 of the main campus, bike racks are located outside almost all of the academic and campus life buildings, those with a red circle, and outside almost all residence halls, those with a yellow circle.

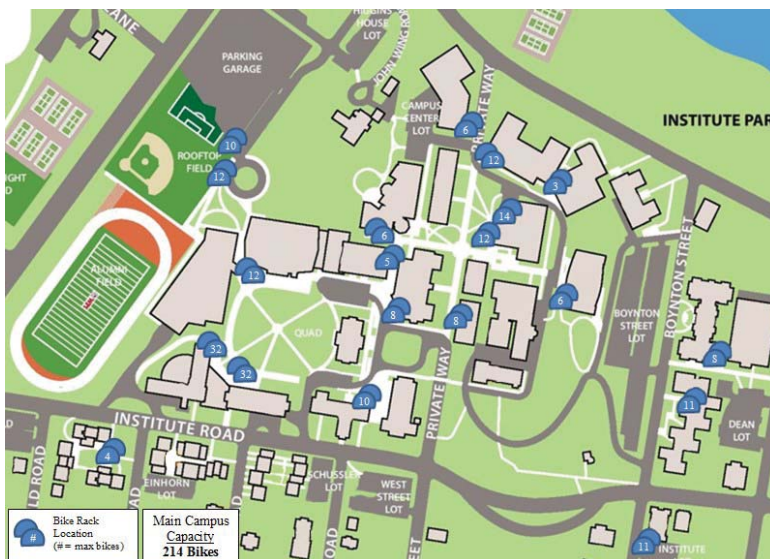


Figure 16: Current locations of bike racks on the WPI main campus.

As seen in Figure 17 of the lower campus, some bike racks are located outside the first Gateway building and many bike racks are located outside Faraday Hall, the residence hall of the lower campus.

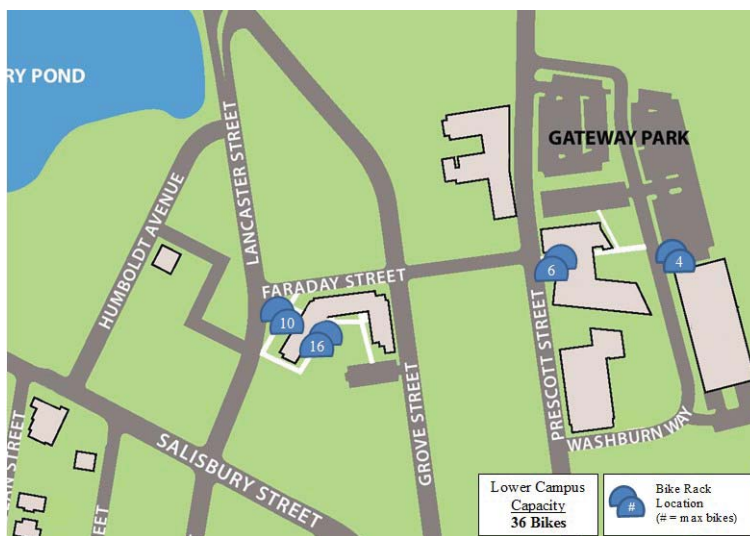


Figure 17: Current locations of bike racks on the WPI lower campus.

Much of our further research for this section came from our interview with WPI's Assistant Vice President for Facilities and the provided information and maps of the 2014 Addendum to the Campus Master Plan.

This Addendum was the result of a study by the WPI Department of Facilities initiated by the WPI Board of Trustees to identify possible sites for future buildings. The addendum focuses on parking improvements, both in the near and long term, current and future pedestrian pathway connections, campus life growth sites, housing growth sites, and academic and research growth sites.

Improvements to Parking on the WPI Campus Have and Will Continue to Make Travel Safer for Pedestrians and Bicyclists.

The overall emphasis of the changes to parking has been to move parking spaces from the campus core to the periphery of campus. Seen in Figure 18 are the changes to the parking infrastructure since 2004. The Dean Street, Gateway Park, and Park Avenue garages were built, adding a total of 1352 parking spaces. This allowed the removal of parking spaces from many spaces within the center of campus. These spaces are marking in red in Figure 18 and are labeled “Recommended Removals” though they have since been removed (“Near Term Parking Improvements”, 2014). Since the 2004 master plan, 240 parking spaces have been removed from the quadrangle (quad), West St. entrance, skull tomb and library service roads, Goddard Hall, West St entrance from Salisbury St, and the circle at Atwater Kent Laboratories. In addition, parking was removed from one side on Boynton St providing increased safety to pedestrian, motorists, and bicyclists. The overall result of the removal of parking from the core of the main campus is that the campus is opened up for safer pedestrian and bike travel.

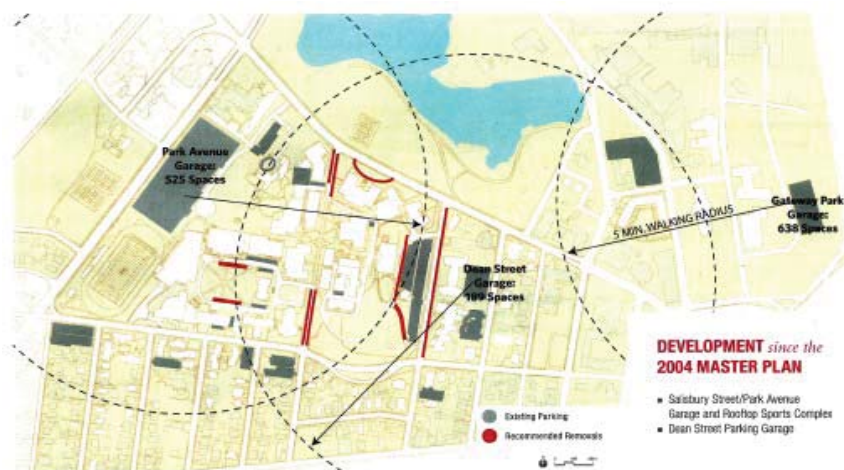


Figure 18: Improvements to parking on the WPI campus since the development of the 2004 Master Plan.

Additionally, in the long term more parking can be removed, such as the spots at Goddard Hall, the library lot, and the lot behind Founders Hall; garages can be built to accommodate additional parking. These recommended changes can be seen in Figure 19 with the red areas denoting recommended parking removal sites and garage building sites (“Long Term Parking Improvements”, 2014).

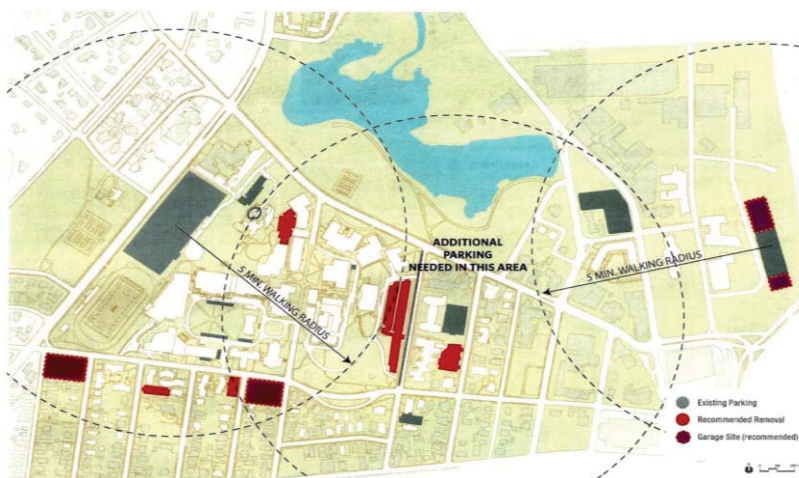


Figure 19: Addendum to the 2004 WPI Campus Master Plan

The Addendum states, that “available spaces [in the Gateway Garage] will do little to help shortage at the main campus.” However, the addition of a bike share, particularly if a bike station was built at the site of the Gateway Garage, could facilitate parking at this garage that can help the shortage at the main campus. Similar to the shuttle that currently stops at the Gateway Garage, access to bikes after parking in the garage would allow users to travel efficiently to the main campus.

The Addendum also states that “Demand management policies should be explored that could help control the need for parking by placing more restrictions on parking users, and by encouraging alternative means of transit, such as implementing ride-share programs, improving busing and biking opportunities.” If such policies were enacted, a bike share may decrease the need of a car on campus for WPI community members. The ability to travel efficiently between the main and lower campuses and from a parking garage to the main campus by bike may decrease the perceived need for a personal car while on campus.

[The Proposed Pedestrian Pathway Connections of the 2014 Addendum to the Campus Master Plan Would Increase the Bikeability of the WPI Campus.](#)

The current and proposed pathways of the 2014 Addendum can be seen in Figure 20. The lighter red or peach-colored, narrow arrows represent current pedestrian pathways while the darker red, thick arrows represent proposed pedestrian pathways.

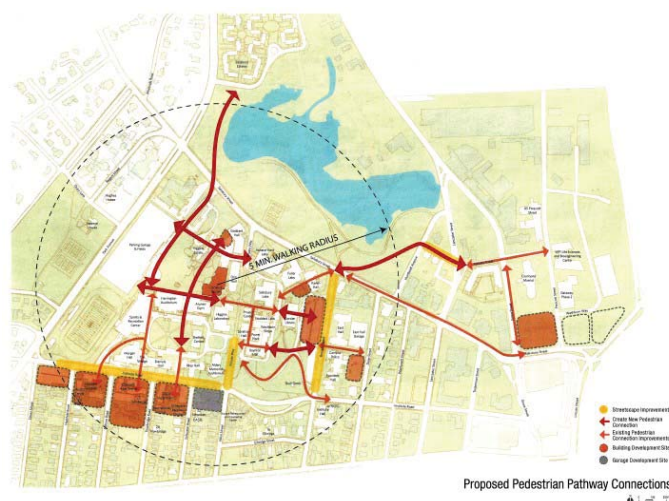


Figure 20: Current and proposed future pedestrian pathway connections in addition to building and garage development sites for the WPI campus.

Figure 21 shows the current pedestrian-only recommended pathways in yellow, the current bike-friendly paths in red, and the proposed bike friendly paths in blue (“Proposed Pedestrian Pathway Connections”, 2014). In this figure, paths are considered pedestrian-only due to the smaller width and typical pedestrian traffic of the paths. It is important to note that these paths are not currently pedestrian only, only that their size and traffic may be reasons why they should be pedestrian-only. Paths were considered bike-friendly if they are of a wider width and / or are less traveled by pedestrians.

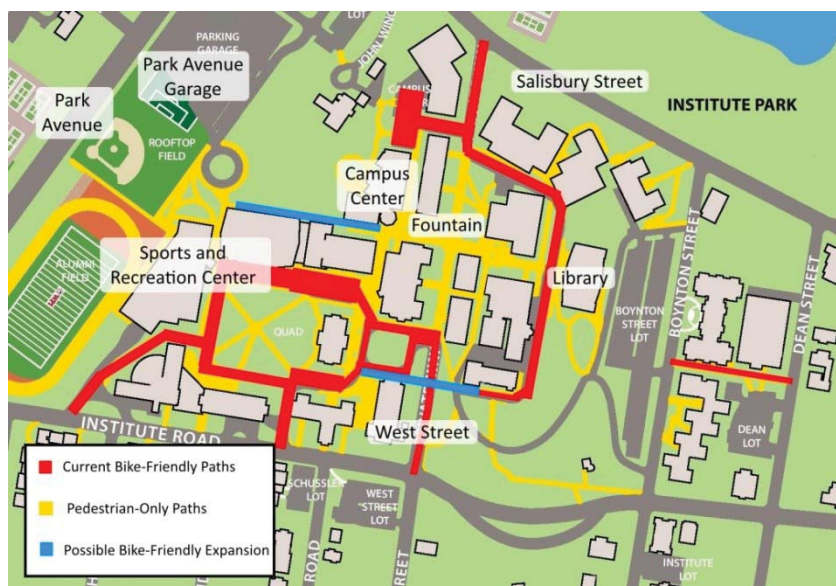


Figure 21: Current Walking- and biking-friendly paths on the WPI main campus, with indications of future bike-friendly expansions.

Two overall goals of the proposed pedestrian pathways for the WPI campus are to facilitate more efficient travel between locations on the campus, and to increase the accessibility of the

campus. WPI's emphasis on accessibility for all users creates accessible pathways but also facilitates pathways suitable for biking.

A proposed connection from the Park Ave Garage to the Campus Center would allow pedestrians and bicyclists to travel directly onto campus instead of taking a roundabout way through the quad. Because of the gradient of the path between the library and garage, this proposed pathway would end in a bridge connecting the path by the campus center to the top level of the Park Avenue Garage. This is an example of the second stated overall goal, that the proposed paths would make routes accessible to all users. This goal of accessibility while improving the ability to travel of those injured or in wheelchairs for example also has a secondary effect on improving bikeability. Paths that have a small gradient which allow wheelchair use also facilitate easy bike use.

One area of the campus that is heavily trafficked, particularly during the time between classes during the day, is the fountain area. This area is in the center of the campus and many pedestrians traveling between academic buildings, the campus center, and the library travel through this one area. This poses a traffic issue for those riding bikes at this time. There is currently no ability for a bicyclist to ride from the west side of the main campus by the quad to the academic side without traveling through the fountain area or another "pedestrian-only" pathway.

A proposed improvement to a current pedestrian pathway exists over Earle Bridge. The east side of the bridge connects directly with the road but the west side of the bridge ends in a short staircase which prevents both accessible and bike travel as seen in Figure 22. There is a plan to eliminate these stairs to allow for handicap accessibility and bike travel over the bridge. This improvement would open up an entire route between the quad, the library, and out West St. to Salisbury St. without having to ride through the fountain area. This would facilitate more efficient and safer traffic flow for pedestrians and bicyclists.



Figure 22: Current pictures of each side of Earle Bridge. Note the ramp on the east (left) side and staircase on the west (right)

With this improvement, a continuous bike-friendly path would exist through the campus as seen in Figure 23.

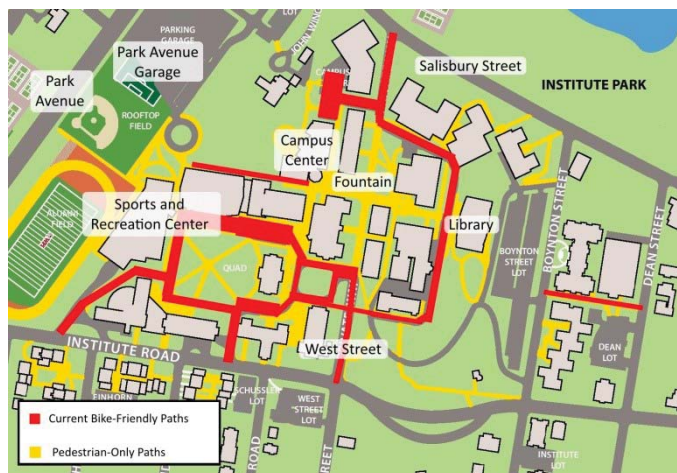


Figure 23: Potential walking- and bike-friendly paths on the WPI main campus, if bike-friendly expansions completed

Another proposed improvement shown in Figure 24 but not shown in Figure 21 is a proposed streetscape improvement (areas highlighted in yellow) is the proposed pathway to Faraday Hall. Much of this path, the portion through Institute Park, has already been completed. However, the connection from the park to the front of Faraday Hall is not yet complete. Currently WPI community members walk down a sidewalk, through a parking lot and down a short set of stairs. There is a proposition to make this handicap accessible and thus more bike-friendly by improving the path and replacing the stairs with a ramp.



Figure 24: Current staircase across the street from Faraday Hall. A proposed improvement includes replacing the staircase with an accessible ramp.

Finally, the proposed pedestrian pathway between the main campus and Salisbury Estates, primarily consisting of graduate student residences, would facilitate easier biking.

Many Recommended Housing, Academic and Research, and Campus Life Sites Exist Toward the Peripheries of Campus and Could Increase the Applicability of Riding a Bike to Locations on Campus.

Figure 25 depicts the housing, academic and research, and campus life growth sites of the 2014 Addendum to the Campus Master Plan (“Housing Growth Sites”, 2014; “Academic and Research Growth Sites”, 2014; “Campus Life Growth Sites”).

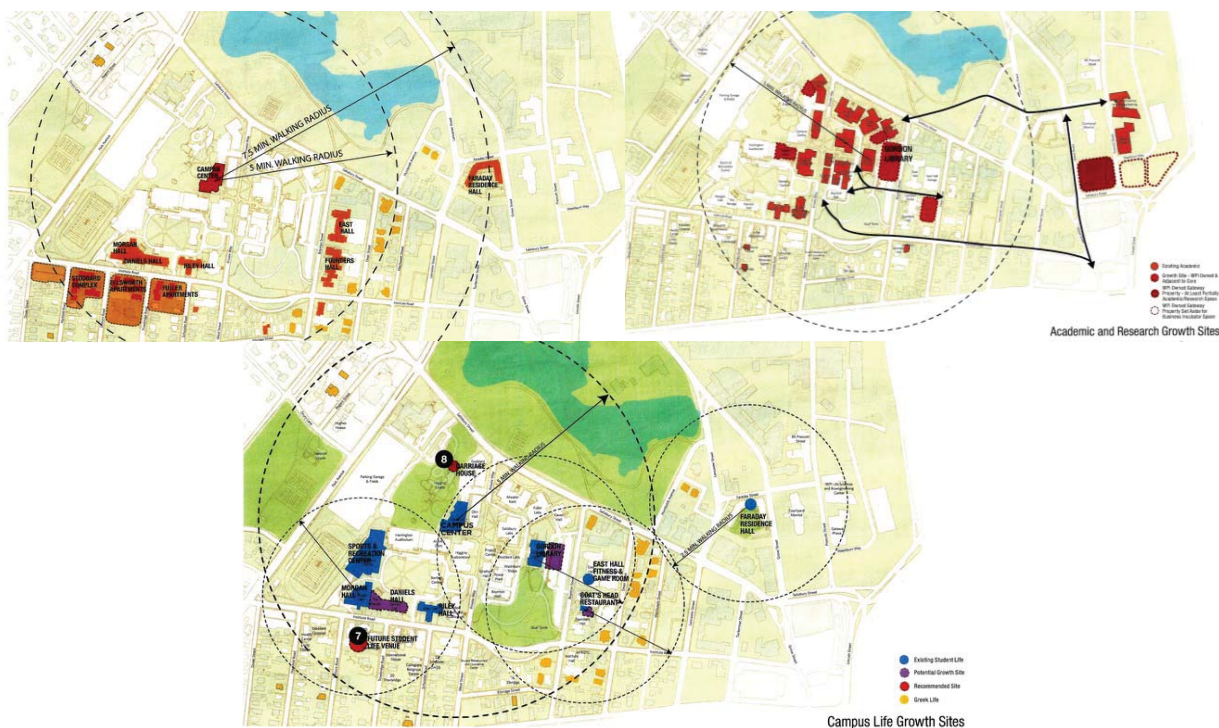


Figure 25: From top left continuing clockwise: Housing growth sites, academic and research growth sites, and campus life growth sites surrounding WPI.

Because many of these growth sites exist beyond the campus core on the main campus, demand for a bike share in the future could increase.

Three Potential Bike Share Locations Exist for a Bike Corral at WPI

Bike share operators stressed the importance that any bike share location be both convenient and visible to maximize use.

We identified three potential locations for a bike corral at WPI: the Gordon Library, Rubin Campus Center, and the Sports and Recreation Center. These are the three buildings on campus that have a desk at which an employee is staffed throughout the building’s operating hours.

Three considerations for the location of a bike corral are building hours, proximity to high concentrations of users, and traffic issues.

Because users can only sign out or check in a bike during a building's operating hours, these hours factor into the decision on where to place the bike share. The hours of operation for each of these buildings can be found in Table 5.

Table 5: Building Operating Hours for Potential WPI Bike Corral Locations

	Gordon Library		Rubin Campus Center		Sports and Recreation Center	
Mon-Thurs	8am - 1am	17	8am - 12am	16	6am - 11pm	17
Friday	8am - 9pm	13	8am - 1am	17	6am - 11pm	17
Saturday	11am - 9pm	10	8am - 1am	17	8am - 11pm	15
Sunday	11am - 1am	14	8am - 12am	16	10am - 11pm	13
Daily Average		13.5		16.5		15.5

Of the three buildings, the Campus Center has the greatest daily average for hours open and has the latest hours on the weekends. However, it does not open any earlier than 8am. The Sports and Recreation Center has the next longest average hours and opens at 6am Monday through Friday. However, it closes at 11pm every day. The library has the shortest daily average for hours open, but is open until 1am Sunday through Thursday. However, it does not open until 11am on the weekends.

With the buildings under consideration, there are two groups of users to consider with respect to proximity. First is the thousands of students in the academic half of the main campus every weekday. With over 4000 undergraduate students alone, a bike corral located in this portion of campus such as at the library or campus center would provide convenient access to a large population. The second group is the more than 700 freshmen living in one of the three residence halls located on the quad as well as any other WPI community member eating in the dining hall in or exercising at the Sports and Recreation Center. A bike corral located at the Sports and Recreation Center would be in close proximity to these potential users.

As discussed in the Findings section, there is sometimes congestion of pedestrians in the fountain area of the main campus, particularly during the times between quarter-of and the hour (12:45 and 1:00) when students are going to or switching between classes. A bike corral set up in a location suited to avoid bike routes through this section would be beneficial.

There are advantages and disadvantages to each of the three potential locations as laid out in Table 6.

Table 6: Bike Location Comparison for a WPI Bike Corral System

Bike Site	Advantages	Disadvantages
Gordon Library	Proximal to academic buildings. Convenient for campus commute.	Fewest operating hours.
	Overhang protects from weather.	Does not open until 11am on weekends.
	Can avoid traffic issues through fountain area.	Closes at 9pm on Friday and Saturday.
		Not proximal to quad.
Rubin Campus Center	Most operating hours.	Traffic issues: Users likely to ride through fountain area
	Convenient hours: opens at 8am and closes at least 12am every day.	Possible construction at Alumni Gym and path could interrupt service
	Central to both academic buildings and quad.	
Sports and Recreation Center	2nd most operating hours.	Closes at 11pm daily.
	Early opening on weekdays: 6am.	Late opening on Sunday: 10am.
	Proximal to quad.	Not proximal to academic buildings.
	Can avoid traffic issues through fountain area.	

Many Potential Bike Share Locations Exist for an Automated Bike Share System at WPI

Because an automated system is not required to be located at a building with a permanent staff member, there are many more potential locations as seen in Table 7.

Table 7: Bike Location Comparison for an Automated Bike Share System at WPI

Bike Site	Advantages	Disadvantages
Quadrangle	High concentration of potential users: 700+ freshmen residents, dining hall.	Not proximal to academic buildings
	Close to west end of campus	
Campus Center	Central to both academic buildings and quad	Traffic issues: Users likely to ride through fountain area
	Close to Campus Center info desk - potential use for helmet distribution	Possible construction at Alumni Gym and path could interrupt service
Gordon Library	High concentration of potential users: Proximal to academic buildings.	Some pedestrian traffic issues
	Close to Library desk - potential use for helmet distribution	Not proximal to quad
	Avoid traffic issues from Salisbury St (avoid fountain if coming from north of campus)	
	Overhang protects from weather	
Faraday Hall (+Gateway)	High concentration of potential users: 258 in Faraday Hall	2 blocks from Gateway Park
	High concentration of potential users: Gateway commuters (faculty, staff, grad students): can walk 2 blocks to bike location	
Arts Walk / East Hall Parking Garage	High concentration of potential users: East Hall and Founders Hall (500 students) + fraternities	
Gateway Park	On site bikes may encourage most use by Gateway users	
	Overhang protects from weather	
Gateway Garage	Garage far from main campus: could encourage parking and then riding bike to campus	At eastern-most edge of campus.

4.6 WPI Organizations Interested in a Bike Share

The Student Green Team, A WPI Student Organization, is Interested in Operating the Bike Share. The goal of the Green Team is to increase the sustainability of the WPI campus, though their approach is cross-disciplinary and not focused on any one discipline. Additionally, the officers have expressed interest in the organization becoming the sole operator of the bike share due to the club's ties to campus sustainability. It would provide the opportunity to improve sustainable campus transportation options. Currently the Green Team hosts a few annual events such as a car show and lighting fair but does is not involved in a permanent initiative. Operating a bike share would enable the Green Team to take part in an ongoing initiative which would serve as good public relations for the organization. The Green Team currently has more than thirty active members and if they operated a bike share, they would be able to recruit additional members interested in its operation and maintenance.

The Fitness Club, a WPI Student Organization, is Interested in Using the Bike Share.

Fitness Club officers stated that from their experience students desire more opportunities to be active. Being able to bike such as in a spin class or having actual bikes for students to use could fulfill this desire. The officers also stated they would like to use a bike share to lead bike rides. The officers envisioned holding a joint event with the club and the bike share during New Student Orientation at WPI to take a tour of the area around WPI.

The WPI Student Government Association (SGA) and Graduate Student Government (GSG) Have Expressed Interest in Helping Fund a Bike Share.

SGA has expressed willingness in providing the start-up funding for such a program in the hope that another funding source pick up the annual funding. They are interested in long-term projects that improve the undergraduate experience and leave a legacy on campus. SGA has stated that they are willing to pay for the proportional amount of undergraduates at WPI. GSG is also interested in helping fund a bike share. GSG is willing to pay for a one-time cost of the program, granting them a sense of ownership of that aspect. In exchange for funding from GSG, they would like the GSG logo be visibly applied somewhere in the bike share. SGA has less interest in supplying the annual funding for a bike share and suggested this portion of funding could be provided from the university.

4.7 Current and Future Bikeability of Worcester, Massachusetts

The City of Worcester is Making Strides to Become More Bike Friendly

Members of the city and regional governments as well as bike advocacy groups in Worcester believe that biking is a priority item in Worcester. The Worcester Division of Planning and Regulatory Services deals with all planning issues for the city, and is becoming increasingly involved in transportation planning. They currently work towards making more bike-friendly areas in the city, but are currently limited to making additions to already-existing projects. They advocate the ideal of “complete streets,” which is the philosophy that municipal streets exist to service all forms of transportation, walking, biking, and vehicular traffic alike. Both the Director of Planning and Regulatory Services and the Sustainability Project Manager are interested in bike sharing, and are curious about the future of bike share programs at Worcester universities.

Based on our interviews with the Division of Planning, the Central Massachusetts Regional Planning Commission, and WalkBike Worcester, we have found that bicycle-friendly projects are encouraged, and, in some cases, under way in Worcester. One project happening in the city is a major overhaul of Main Street in downtown Worcester, seen in Figure 26. Currently in the planning stage, this project deals with changing the streetscape of this wide street, and the Planning Office plans on including improved bike infrastructure in the project.



Figure 26: Main Street, Worcester, MA

Recently, shared-lane arrow markings (or “sharrows”) have been painted on Lincoln St., a road northeast of the WPI campus, among other streets around Worcester, and it is possible that more will be painted on Highland Street. Some other streets in the vicinity of WPI currently with sharrows are West St., Lincoln St., and North Ashland St., as seen in Figure 27.



Figure 27: Sharrows in Worcester on (left to right) West St., North Ashland St. and Lincoln St.

Worcester has also made strides to make the Canal District in southeastern Worcester more bike friendly by including painted bike lanes on Temple St., Harding St. and Green St. as seen in Figure 28. Also depicted is a bike lane on Elm St.



Figure 28: Bike Lanes, Worcester, MA. From left to right: Elm St., Temple St., Harding St., and Green St.

In addition to these painted markings, many “Share the Road” signs, as seen in Figure 29, have been placed around the city to alert motorists to bicyclists on the road. These signs are sometimes placed after a bike lane ends to tell motorists to then expect bikes in the road that had previously been in a bike lane.

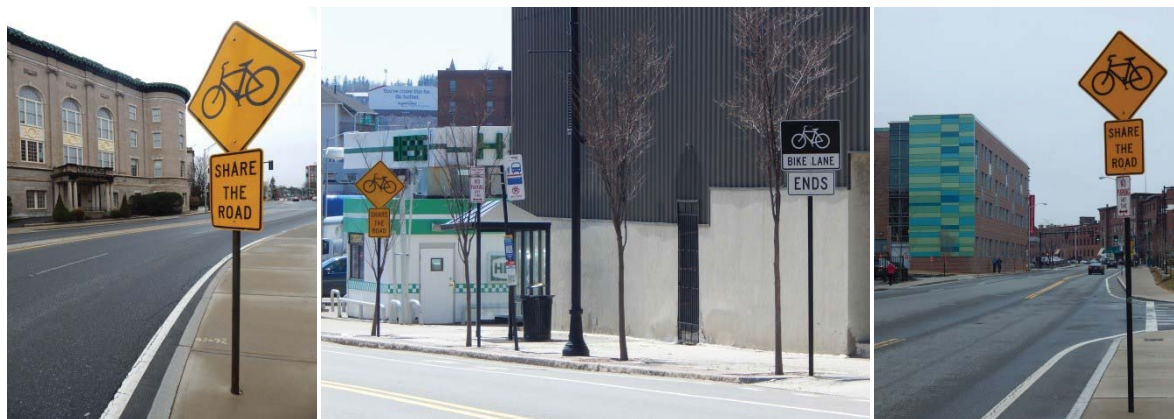


Figure 29: “Share the Road” signs in Worcester, MA. From left to right: Salisbury St. across from Tuckerman Hall, Green St., and Grove St. by Faraday Hall.

Additionally, the city is working in conjunction with the Massachusetts Department of Transportation to develop connections to the Blackstone Valley Bikeway. The ultimate goal is to construct a bikeway to connect Worcester, Massachusetts to Providence, Rhode Island (Blackstone River Greenway - Bike Path, 2014). Small portions of this path have been completed, and others are currently being constructed. The segment called the Quinsigamond Bike Spur, connecting the Middle River / Blackstone Gateway Park with Blackstone River Road is expected

to be completed within the next year (Blackstone River Greenway - Bike Path, 2014). On-street bike lanes on Quinsigamond Ave in Worcester are taken care of by the city of Worcester. The city is also working on the northernmost portion of the bikeway with a one-mile separated bike path to connect Worcester Union Station to Crompton Park. From here, the bikeway follows Millbury St to Blackstone River Road (Blackstone River Greenway - Bike Path, 2014). The Worcester Union Station connection is expected to be complete within five years.

Worcester Does Not Yet Have the Resources or Personnel to Focus on Bicycling Full Time.


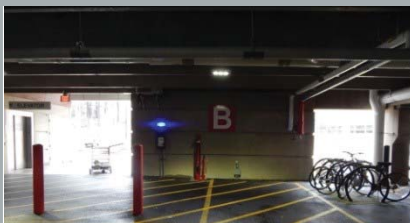



Some large cities have an appointed position, sometimes termed a “Bike Czar,” which deals with all matters relating to biking in that city. Worcester does not have an equivalent position or group that deals with biking issues, but rather a collective of people in the city government who keep bike accessibility in mind when making decisions. Additionally, advocacy groups such as WalkBike Worcester and the Central Massachusetts Regional Planning Commission (CMRPC) work to improve the quality of bicycling in the city. We also found that there are few resources or city laws that specifically deal with biking. In planning large projects in the city, portions of project budgets are sometimes allocated to creating bike infrastructure such as sharrows, painted bike lanes, or bike racks. The city is currently working on ordinances that deal with biking, but including bikes in city projects is only encouraged as good practice at the moment.

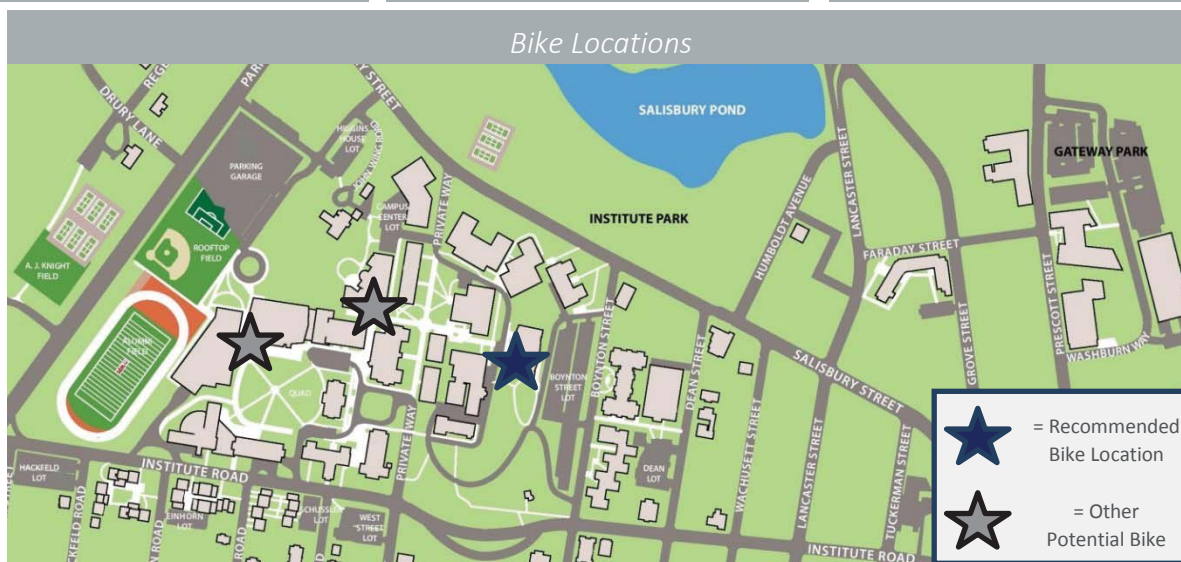
CHAPTER 5: IMPLEMENTATION PLANS

This section contains Implementation plans for bike shares at WPI. Each plan was developed by taking into account each of the 14 Essential Aspects of a University Bike Share. The following pages summarize each of four plans of various bike share systems: bike corral, tech-on-bike, automated key box PC-based, and automated key box web-based (Brayj, n.d.; “Bike share customer fleet bicycle”, n.d.; Huggins, n.d.; [Untitled photograph of helmet] n.d.). A full analysis for each plan can be found in APPENDIX A: IMPLEMENTATION DETAILS.

BIKE SHARE IMPLEMENTATION PLAN






Bike Corral

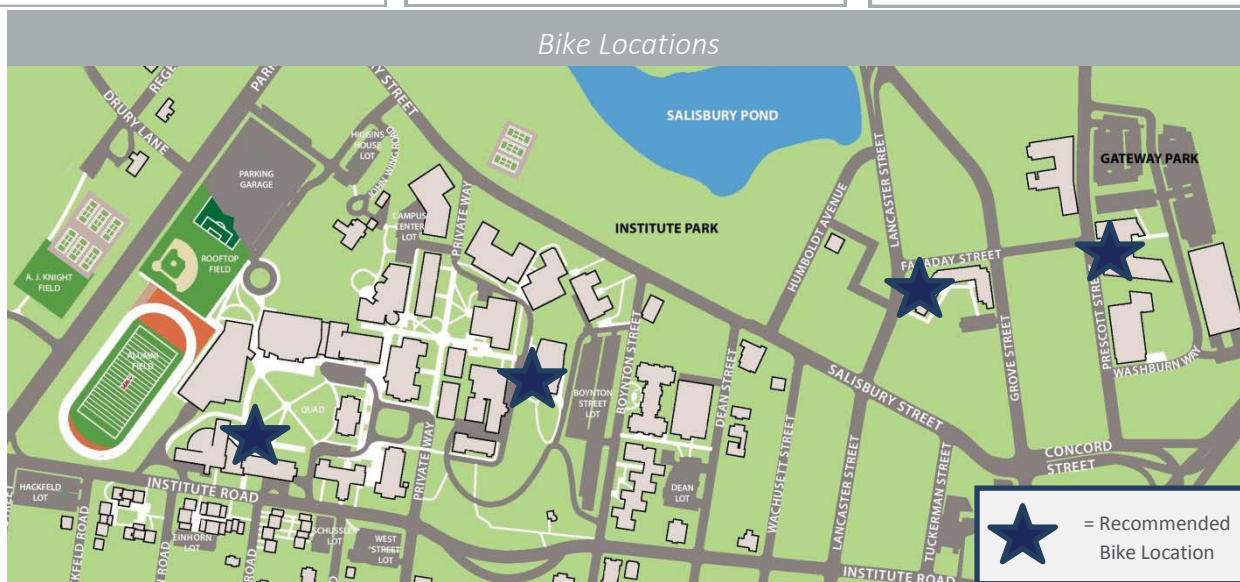
Users WPI Faculty, Staff, Undergrad., & Grad.	First Year Cost (Used-New) \$3,815 - \$10,215	User-Sign Up <u>Create Website</u> <u>Education:</u> On bike safety, maintenance, routes, rules of the road <u>Liability Waiver</u>
Operators WPI Student Green Team + Faculty / Staff Advisor(s)	Subsequent Years' Cost \$400	
	Cost to User \$0	
Sign-Out / Log Method Manual, Log Book Helmet Distribution	Checkout Format / Time 	Workshop / Winter Storage 
	Ride-and-Return 8 Hours / Building Close	Garage / Small Room
Bike Number 16 Bikes	Bike Type 	Bike Lock 
	Used / New	U-Lock



BIKE SHARE IMPLEMENTATION PLAN

Tech-on-Bike (Zagster)

<p>Users</p> <p>WPI Faculty, Staff, Undergrad., & Grad. Students</p>	<p>First Year Cost (16-31 Bikes)</p> <p>\$19,200 - \$37,200</p> <p>Subsequent Years' Cost</p> <p>\$19,200 - \$37,200</p> <p>Cost to User</p> <p>\$0</p>	<p>User-Sign Up</p> <p><u>Zagster Website</u></p> <p><u>Education:</u> On bike safety, maintenance, routes, rules of the road</p> <p><u>Liability Waiver</u></p>
<p>Operators</p> <p>WPI Student Green Team + Faculty / Staff Advisor(s)</p>	<p>Sign-Out / Log Method</p> <p>App / Online, Key Box on Bike</p> <p>Helmet Distribution</p>  <p>Given Free to Users</p>	<p>Checkout Format / Time</p>  <p>Ride-and-Return / 8 Hours</p>
<p>Bike Number</p> <p>Minimum: 16 Bikes</p> <p>Maximum: 31 Bikes</p>	<p>Bike Type</p>  <p>Breezer Uptown</p>	<p>Workshop / Winter Storage</p> <p>All Maintenance Provided</p>  <p>Garage / Small Room</p>
	<p>Bike Lock</p>  <p>U-Lock</p>	



BIKE SHARE IMPLEMENTATION PLAN

Automated Key Box - PC Based (On Bike Share)

Users

WPI Faculty, Staff, Undergrad.,
& Grad. Students

Operators

WPI Student Green Team +
Faculty / Staff Advisor(s)

First Year Cost (16-31 Bikes)

\$18,772 - \$35,432

Subsequent Years' Cost

\$400 - \$800

Cost to User

\$0

User-Sign Up

Create Website

Education: On bike safety,
maintenance, routes, rules of
the road

Liability Waiver

Sign-Out / Log Method

Automated Key Box

Helmet Distribution



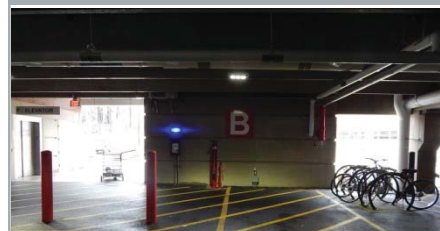
Given Free to Users

Checkout Format / Time



Ride-and-Return / 8 Hours

Workshop / Winter Storage



Garage / Small Room

Bike Number

Minimum: 16 Bikes
Maximum: 31 Bikes

Bike Type



On Bike

Bike Lock








Integrated U-Lock

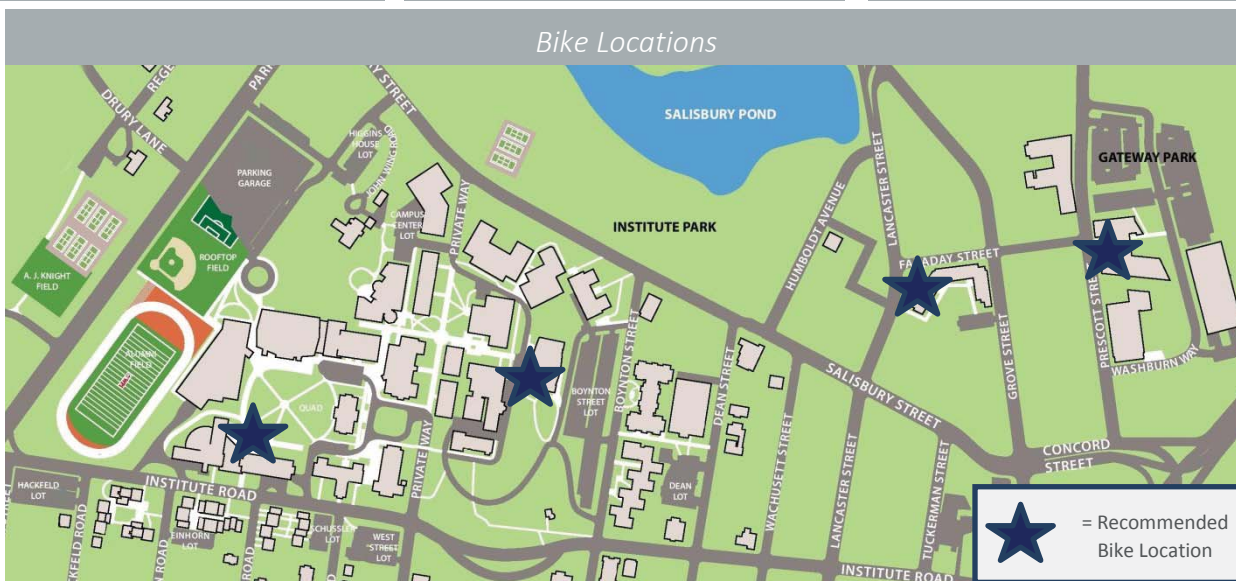
Bike Locations



BIKE SHARE IMPLEMENTATION PLAN

Automated Key Box - Web Based (On Bike Share)

<div>Users</div> <div>WPI Faculty, Staff, Undergrad., & Grad. Students</div> <div>Operators</div> <div>WPI Student Green Team + Faculty / Staff Advisor(s)</div>	<div>First Year Cost (16-31 Bikes)</div> <div>\$22,292 - \$42,252</div> <div>Subsequent Years' Cost</div> <div>\$1,200 - \$2,350</div> <div>Cost to User</div> <div>\$0</div>	<div>User-Sign Up</div> <div><u>On Bike Share Website</u></div> <div><u>Education: On bike safety, maintenance, routes, rules of the road</u></div> <div><u>Liability Waiver</u></div>
<div>Sign-Out / Log Method</div> <div>App, Automated Key Box</div> <div>Helmet Distribution</div> <div></div> <div>Given Free to Users</div>	<div>Checkout Format / Time</div> <div></div> <div>Ride-and-Return / 8 Hours</div>	<div>Workshop / Winter Storage</div> <div></div> <div>Garage / Small Room</div>
<div>Bike Number</div> <div>Minimum: 16 Bikes</div> <div>Maximum: 31 Bikes</div>	<div>Bike Type</div> <div></div> <div>On Bike</div>	<div>Bike Lock</div> <div></div> <div>Integrated U-Lock</div>



Seen below in Table 8 is a comparison for key attributes of each implementation plan. The color coding represents what we believe to be the ranking of each attribute. The darkest color represents the best option while the lightest color represents the weakest option for that aspect.

Table 8: Comparison of attributes of each implementation plan

	Bike Corral	Tech-on-Bike	Automated Key Box - PC	Automated Key Box - Web
Hours	Building Hours	24/7	24/7	24/7
Locations	1	4	4	4
Data Collection	Manual – Log Book	Automatic, Real-Time	Automatic, Manual Collection	Automatic, Real-Time
PIN	N/A	Single-Use	Annual	Single-Use
Bike	Used/New	Breezer Uptown	On Bike	On Bike
First Year Cost (16-31 Bikes)	\$3,873-\$4,784 (Used) \$10,273-\$17,184 (New)	\$19,200-\$37,200	\$18,244-\$34,904	\$21,764-\$41,724
Subsequent Years' Cost (16-31 Bikes)	\$400-\$800	\$19,200-\$37,200	\$400-\$800	\$1,200-\$2,350

Our recommendation for a bike share system for WPI is the Automated Key Box – Web version. This is an automated system that is able to be run 24 hours a day, 7 days a week. The system is completely modular it can be placed any place one could install a normal bike rack. The automatic, real-time data collection helps the operators efficiently run the bike share. For example, with the PC version, operators have to periodically manually upload data from the key boxes. If a bike is not returned on time or not at all, the operators may not know until they upload the data.

Among many problems, the main problem with the bike corral is that since it must be located with a permanent staff member. No such location exists on the lower campus so a bike corral could not be placed there. This would leave the large source of potential users without convenient access to the bike share.

Though the Tech-on-Bike system is very convenient for many reasons, the subsequent years' cost quickly makes it a much more expensive system than the other options.

CHAPTER 6: RECOMMENDATIONS

This chapter focuses on the specific recommendations we are giving to achieve our goal of reducing unsustainable transportation on the WPI campus. These recommendations are based on our research and findings above.

We recommend a bike share for all students, faculty and staff be implemented at WPI.

A bike share fulfills the goals of reducing single-occupancy vehicle use on campus, making WPI a more sustainable campus, and providing an alternative transportation option. The WPI campus is bikeable and has sufficient infrastructure, as evidenced by past and future bike-friendly projects and the large amount of bike racks on campus. Also, removing parking spaces on campus has made WPI a safe place to walk and ride. Similarly, the city of Worcester is working on bike related projects, such as adding bike lanes and sharrows when possible.

A significant proportion of each user group; faculty, staff, undergraduate, and graduate students has expressed the willingness to change travel method with the implementation of a bike share. Additionally, benefits of a bike share exist for each group.

We recommend that the WPI bike share be jointly funded by the university, Student Government Association (SGA), and Graduate Student Government (GSG).

SGA and GSG have expressed willingness in providing the start-up funding for such a program in with another funding source covering the annual funding. They are interested in long-term projects that improve the undergraduate experience and leave a legacy on campus. SGA has stated that they are willing to pay for the proportional amount of undergraduates at WPI. GSG is willing to pay for a one-time cost of the program, granting them a sense of ownership of that aspect. Funding from the university would cover the remaining start-up cost representing faculty and staff and would cover the subsequent years' cost as well.

We recommend one of the Implementation Plans laid out in this document be executed.

The options are for a bike corral, an automated key box system, or a tech-on-bike system. Each of these three programs has unique benefits and challenges. The bike corral is a very inexpensive program that does not fulfill all of the transportation needs of WPI, particularly when compared to other systems. Many of the university programs we have studied expressed a desire in a more automated system to improve both operations and the user experience. The automated key box system is closer to complete automation, but is more expensive than a bike corral. This system provides dynamic checkout system and automatic data collection for the operators to use. An automated key box system still requires that the operator maintain all of the bikes in the program. The tech-on-bike program is fully automated, in that users can check out and return a bike on their own, and the operators have very little to do with running the program. All maintenance is provided by the company, Zagster. This system comes at a very high yearly cost, which may not be feasible in the long term.

Specifically, we recommend the web-based automated key box system be implemented.

The web-based version of the automated key box system provided by On Bike Share provides the most benefits to WPI. The app-based checkout system and key box automation make this option convenient to both riders and operators. Riders can take a bike whenever they want, and operators can receive bike use data in real time. If there is a problem with a bike in the share, the operator will be equipped to recognize and deal with it quickly. This is in contrast to the PC based system, where the operators must periodically manually download the bike use data. We believe the automated key box is the most cost effective option for its functionality.

We recommend the bike share be operated by the WPI Student Green Team with the assistance of a faculty and / or staff advisor.

As the largest sustainability-focused group on campus, the Student Green Team is both willing and able to operate a bike share. They are interested in having ownership of a campus-wide program such as a bike share. The Green Team currently has a large active membership who could be involved in leading or helping the bike share succeed. Additionally, the Green Team would recruit additional members specifically to assist in operating the bike share. We recommend at least one faculty or staff member serve as an advisor to the bike share to maintain leadership during leadership transitions within the Green Team.

We recommend additional bike racks be installed at Gateway Park to accommodate increased bike traffic.

As seen in Figure 17, there is limited bike capacity at Gateway Park. The racks in front of the building are often filled during the day and the racks behind the building at the parking garage are inconvenient for users riding from the main campus to Gateway. If a bike share is implemented, additional racks are required to accommodate increased daily bike traffic from the main campus.

APPENDIX A: IMPLEMENTATION DETAILS

This chapter contains four implementation plans for a bike share at WPI developed through analysis of the findings from the previous section. Each plan is of a different bike share system: the first plan is a bike corral, the second and third are automated key box systems, but with PC-based and web-based management software respectively, and the fourth is a tech-on-bike system. To create each implementation plan, each of the 14 Essential Aspects of a University Bike Share was considered and a recommendation is included based on that system and how that system would work at WPI. The fifth section of this chapter presents a comparison of each of the aspects for each plan as well as advantages and disadvantages of each plan.

Table 9 contains the recommendations for each plan based on each essential aspect of a university bike share. The color coding represents what we believe to be the ranking of each aspect. The darkest color represents the best option while the lightest color represents the weakest option for that aspect.

Table 9: Recommendations for the 14 Essential Aspects of a University Bike Share

		Bike Corral	Zagster	On Bike Share - PC	On Bike Share - Web
1	Bike Share System	Bike Corral	Tech-On-Bike	Automated Key Box – PIN	Automated Key Box - App
2	Bike Sign Out / Log Method	Manual	Automated - App, Bike key box PIN	Automated - Rack Key Box PIN	Automated - App, Rack Key Box PIN
3	Bike Locations (# and Placement)	1 (Library)	4 (Quad, Library, Faraday, Gateway)	4 (Quad, Library, Faraday, Gateway)	4 (Quad, Library, Faraday, Gateway)
4	Bike Locks	U-Lock	U-Lock	Integrated U-Lock	Integrated U-Lock
5	Bike Type	Used / New	Breezer Uptown	Shimano Nexus 7-speed internal gearing	Shimano Nexus 7-speed internal gearing
6	Number of Bikes	16 (limited expansion)	16 - 31	16 – 31	16 - 31
7	Bike Share Operator(s)	WPI Green Team + Advisors	WPI Green Team + Advisors	WPI Green Team + Advisors	WPI Green Team + Advisors
8	Bike Share Users	Faculty, Staff, Undergrad, Grad	Faculty, Staff, Undergrad, Grad	Faculty, Staff, Undergrad, Grad	Faculty, Staff, Undergrad, Grad
9	Checkout Format	Ride-and-Return	Station-to-Station or Ride-and-Return	Ride-and-Return	Ride-and-Return
10	Checkout Time	8 Hours (+ Tied to staff)	8 Hours	8 Hours	8 Hours
11	Cost to User	\$0 (+ Late Fee)	\$0 (+ Late Fee)	\$0 (+ Late Fee)	\$0 (+ Late Fee)
12	Workshop Space and Maintenance	Garage / Small Room	Zagster provides all maintenance	Garage / Small Room	Garage / Small Room
13	Winter Storage Space	Garage / Small Room	Garage / Small Room	Garage / Small Room	Garage / Small Room
14	User Sign-Up, Liability, & Education	Create website : Education, liability waiver	Zagster website	Create website : Education, liability waiver, PIN	On Bike website: program info and liability waiver.

A.1 Bike Corral

A bike corral is a manual bike share program in which users sign out a bike at a location with a staff member.

1. Bike Share System: Bike Corral

Per the title of this plan, the first potential bike share system is a bike corral which is most often characterized by a manual sign-out system from one or more central locations. The bike share system is dependent on many of the specific answers to many of the other essential aspects. A description of the system would contain many of the following aspects.

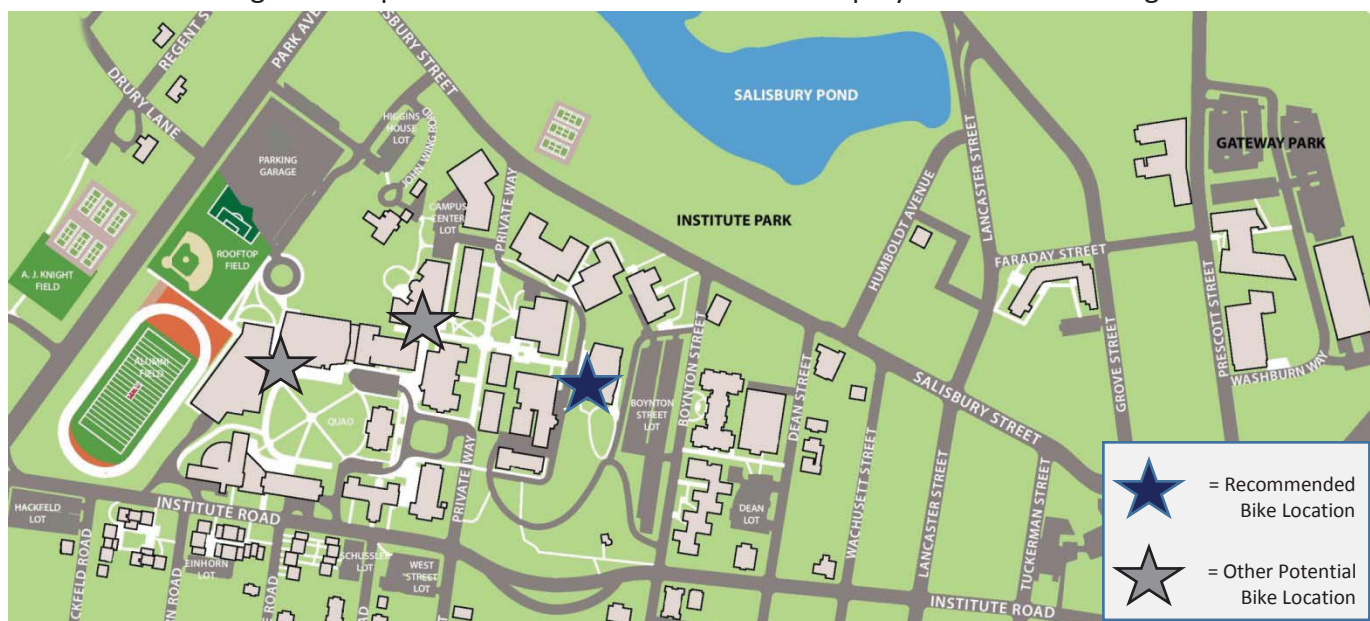
2. Bike Sign Out / Log Method

Organize a manual system in which users sign out bikes in a logbook located at location with a staff member. At sign-out, the user inputs, with the desired bike's number, identifying information such as name, school username, ID number, or email as well as the date and time the bike is signed out. Once this information has been provided, the user is supplied with a key to the lock of the desired bike as well as a helmet if desired. Helmets are stored at the bike share location to provide easy access. When the bike is returned, the date and time are written down. At this point the user also has the opportunity to fill out a maintenance request form if any issues with the bike exist.

Identifying information is important in case the bike is damaged, is not returned on time, or is not returned at all. This information allows the operator to follow up with the user to find out what happened and apply fines or other action. The sign-out and check-in dates and times are critical for determining if a bike was returned on time. The identifying information and date and time provide incentive for the user to return the bike on time to avoid a penalty or fine.

3. Bike Locations (Number and Placement)

As described in the Findings chapter, we identified three potential locations for a bike corral at WPI: the Gordon Library, Rubin Campus Center, and Sports and Recreation Center. These are the three buildings on campus that have a desk at which an employee is staffed throughout the



building's operating hours.

The three considerations for the location of a bike corral are building hours, proximity to high concentrations of users, and traffic issues. There is no ideal building that accounts for all three of these factors.

Because the three locations are all on the main campus and relatively close to each other, we recommend that only one be chosen as a bike share location.

We recommend Gordon Library be used as the location. Though it has the fewest operating hours and is not proximal to the quad, it is proximal to all the academic buildings and is thus convenient for the campus commute. There is also an overhang at the library location that would protect the bikes from the weather. Finally, users can avoid the current traffic issue of riding through the fountain area.

4. Bike Locks

U-locks provide the most security for bikes. When stationed at the Library, the bikes are locked to bike racks. A user receives a key from the main desk at the library for the lock of a specific bike which the user takes with him or her. This allows the user to ride and safely secure the bike anywhere on campus or in the city.

5. Bike Type

There are two options for bike type. First is to obtain refurbished bikes from Worcester Earn-a-Bike, an organization that allows individuals volunteer in their shop or repairing bikes. Once an individual works for ten hours, they receive a free bike. Members of the bike share operators could work toward earning bikes. This method will be very inexpensive as the bikes are free. It would also give members of the share experience in bike repair, which will be useful in keeping up with maintenance. This is the option that Clark used, and they are very satisfied with the quality of the bikes. Additionally, NYU reported that users prefer their used bikes than the new ones. Riders develop a bond with a particular bike, giving them a larger sense of responsibility.

The second option is to purchase new bikes, likely from a bike shop. These bikes would, at least theoretically, have less maintenance problems and would be easier to maintain and put less of a strain on the bike share operators.

6. Number of Bikes

Our minimum recommendation for WPI is for sixteen bikes. Because of limited space outside the library, this is likely the maximum capacity for bikes in a bike corral system at WPI.

7. Bike Share Operator(s)

The day to day operations and marketing of the bike share will be run by the WPI Student Green Team. Because maintenance of the bikes is essential for a successful bike share, the

Green Team will recruit additional members beyond their current membership who are interested in maintaining the bikes.

Additionally, we recommend a faculty and / or staff member serves in an advisory role for the bike share and oversee its operation. While the Green Team members will run the day to day operations, it is important that a supervisor ensures tasks weekly or monthly tasks are accomplished. Additionally, this advisor would serve to maintain continuity of leadership during Green Team officer transitions.

Operations Plan

2-3 Times per Week

- Check bikes for appropriate tire pressure, brake status

Once a Month

- Each bike should be fully maintained
- To do so, have a weekly maintenance time (for example two hours on a Sunday)
 - Each week, pull 4 of the 16 bikes for maintenance
 - Tighten all bolts, brakes, pedals etc.
 - Fix any other issues

When user submits a maintenance request

- Immediately take bike out of operation
- Either immediately fix or hold until regularly scheduled Sunday maintenance

Keep permanent record of bike use and maintenance.

Market and promote bike share.

8. Bike Share Users

The bike share is open to all undergraduate and graduate students, faculty and staff.

9. Checkout Format

A bike corral uses the Ride-and-Return checkout format. A user returns a bike to the rack from which it was taken. A bike is signed back in when the bike is locked on location and the key is returned.

10. Checkout time

The bikes can be signed out and returned after 8 hours or 30 minutes before the building closes, whichever comes first. The latest a bike can be returned is 30 minutes before the building closes to allow building employees to check in last minute bikes and still have time to close and leave on time. For example, if the building closes at 11pm, the bikes are due at 10:30pm.

To instill accountability to the users for keeping the bikes safe and returned on time, a fee system is put in place. A way to charge student accounts for late or damaged bikes must be set up.

- 1st Late: Emailed warning

- 2nd Late and beyond: Monetary fine
 - The late fee should be based on the number of hours returned late. If a bike is not returned by 24 hours, an additional charge may be made. If the bike is not returned at all, the user is charged for the full cost of replacing the bike.
- Users are not responsible wear and tear of the bikes, but any significant damage beyond this expected amount is subject for charge.

11. Cost to User

There should be no cost to users in an effort to increase sustainable transportation on the WPI campus. The benefit to the university is the improved sustainability and decreased single-occupancy vehicle use among all the other benefits listed in the Findings. In order to build up a base of supporters it is important for it to be free to join the bike share. If in the future it is determined a base of users has been established, the possibility of charging a membership fee can be evaluated.

12. Workshop Space and Maintenance

A space to maintain the bikes is required. Though basic maintenance can be done on location, a workshop is required for more in depth maintenance. If a small space is available in building on campus, it would be closer to the bike share location. If not, our contact in the Department of Facilities envisions a space being set aside for a bike storage and maintenance area.

13. Winter Storage Space

The bikes will be stored in a protected space during the winter to protect the bikes from the winter weather. To simplify logistics and reduce costs, this space is the same as the workshop and maintenance space. There must be room to store or hang the 16 bikes.

14. User Sign-Up, Liability, & Education

Create a website for the bike share to allow users to sign up online. The website should include educational videos followed by a quiz to check understanding. The purpose is to ensure users know how to properly and safely use a bike such as how to use the gears, brakes, seat adjustment, etc. In addition, it should provide information about basic skills to personally check if bike is safe to ride such if the brakes work and all the joints are tight. Finally, the user should fill out and electronically sign a liability form created by the university. In this, the user agrees to be liable for a damaged or lost bike and that the school is not liable for any injury sustained while using the bike share.

A.2 Tech-on-Bike

This is a fully-automated system using the technology from Zagster.

1. Bike Share System

The Tech-on-Bike uses technology from Zagster including specially designed bikes with electronic key boxes installed over the rear tire. As with the bike corral, the system is

characterized by the answers to the essential aspects that follow. To learn how this system works for users, see section 2 and how the bike share is maintained, see section 7.

2. Bike Sign Out / Log Method

This is a fully-automated system that does not require a bike share location be at a building staffed with an employee. The technology required for sign-out is the key box on the bike itself and an internet connection or smart phone application (app).

Once a user has enrolled in the program, he or she uses a computer or the app to request a PIN for a specific bike key box which the user enters to open that key box. The user then takes the key and closes the key box and is free to ride the bike to any location before returning the bike to the same rack location in an allotted amount of time. Upon check-in, the user uses the app to get a new PIN to open the return the key to the box.

Every time a user requests a PIN, the date, time, and user information are recorded via the server. This provides real-time, automatic data acquisition.

3. Bike Locations (Number and Placement)

These locations are at areas of a high concentration of potential users. From left to right in xxx below are the locations on the Quad, an area with close access to four of five freshman residence halls and two upperclassman residence halls as well as people using the Quad or eating in the dining hall. The library is on the academic portion of campus which sees thousands of students and employees passing through every day. The next is at Faraday Hall, home to more than 250 students. The last location is at Gateway Park, with over 40 faculty members as well as staff and many graduate students.



4. Bike Locks

A U-lock is provided with the bikes from Zagster.

5. Bike Type

The Breezer Uptown will be used.

6. Number of Bikes

Minimum: 16

Maximum: 31

7. Bike Share Operator(s)

The day to day operations and marketing of the bike share will be run by the WPI Student Green Team. With this tech-on-bike system, all maintenance is provided by Zagster contractors.

Additionally, a faculty and / or staff member serves in an advisory role for the bike share and oversees its operation. While the Green Team members will run the day to day operations, it is important that a supervisor ensures tasks weekly or monthly tasks are accomplished. Additionally, this advisor would serve to maintain continuity of leadership during Green Team officer transitions.

Operations Plan

Market and promote bike share.

8. Bike Share Users

The bike share is open to all undergraduate and graduate students, faculty and staff.

9. Checkout Format

This system uses the Ride-and-Return checkout format. A user returns a bike to the location, but not necessarily the exact rack from which it was taken. A bike is signed back in when the bike is locked on location and the key is returned to the key box.

10. Checkout time

The bikes can be signed out for up to 8 hours.

To instill accountability to the users for keeping the bikes safe and returned on time, a fee system is put in place. A way to charge student accounts for late or damaged bikes must be set up.

- 1st Late: Emailed warning
- 2nd Late and beyond: Monetary fine

- The late fee should be based on the number of hours returned late. If a bike is not returned by 24 hours, an additional charge may be made. If the bike is not returned at all, the user is charged for the full cost of replacing the bike.
- Users are not responsible wear and tear of the bikes, but any significant damage beyond this expected amount is subject for charge.

11. Cost to User

There should be no cost to users in an effort to increase sustainable transportation on the WPI campus. The benefit to the university is the decreased single-occupancy vehicle use. In addition, in order to build up a base of supporters it is important for it to be free to join the bike share. If in the future it is determined a base of users has been established, the possibility of charging a membership fee can be evaluated.

12. Workshop Space and Maintenance

A space to maintain the bikes is required. Though basic maintenance can be done on location, a workshop is required for more in depth maintenance. If a small space is available in building on campus, it would be closer to the bike share location. If not, our contact in the Department of Facilities envisions a space being set aside for a bike storage and maintenance area.

13. Winter Storage Space

The bikes will be stored in a protected space during the winter to protect the bikes from the winter weather. To keep logistics simple, this space is the same as the workshop and maintenance space. There must be room to store or hang the 16 bikes.

14. User Sign-Up, Liability, & Education

Create a website for the bike share to allow users to sign up online. The website should include educational videos followed by a quiz to check understanding. The purpose is to ensure users know how to properly and safely use a bike such as how to use the gears, brakes, seat adjustment, etc. In addition, it should provide information about basic skills to personally check if bike is safe to ride such if the brakes work and all the joints are tight. Finally, the user should fill out and electronically sign a liability form created by the university. In this, the user agrees to be liable for a damaged or lost bike and that the school is not liable for any injury sustained while using the bike share.

A.3 Automated Key Box – PC Based Management Software

This is a semi-automated system using the technology from On Bike Share.

1. Bike Share System

The Automated Key Box system uses technology from On Bike Share including specially designed bike racks with electronic key boxes installed and specially designed bikes. As with the bike corral, the system is characterized by the answers to the essential aspects that follow. To learn how this system works for users, see section 2 and how the bike share operators set up the key boxes, see section 7.

2. Bike Sign Out / Log Method

This is a semi-automated system that does not require a bike share location be at a building staffed with an employee. All of the technology required for sign-out is the key box on the bike rack itself as seen in Figure 30 (“Bike share rack with electronic key box, n.d.”). The key box has a number pad on the outside and contains the key to the bike locked to that specific rack. Once a user has enrolled in the program, he or she receives a personal identification number (PIN). The user enters this PIN to open any key box in the bike share. The user then takes the key and closes the key box and is free to ride the bike to any location before returning the bike to the same exact rack in an allotted amount of time. Upon check-in, the user again enters the assigned PIN to open the box and return the key.

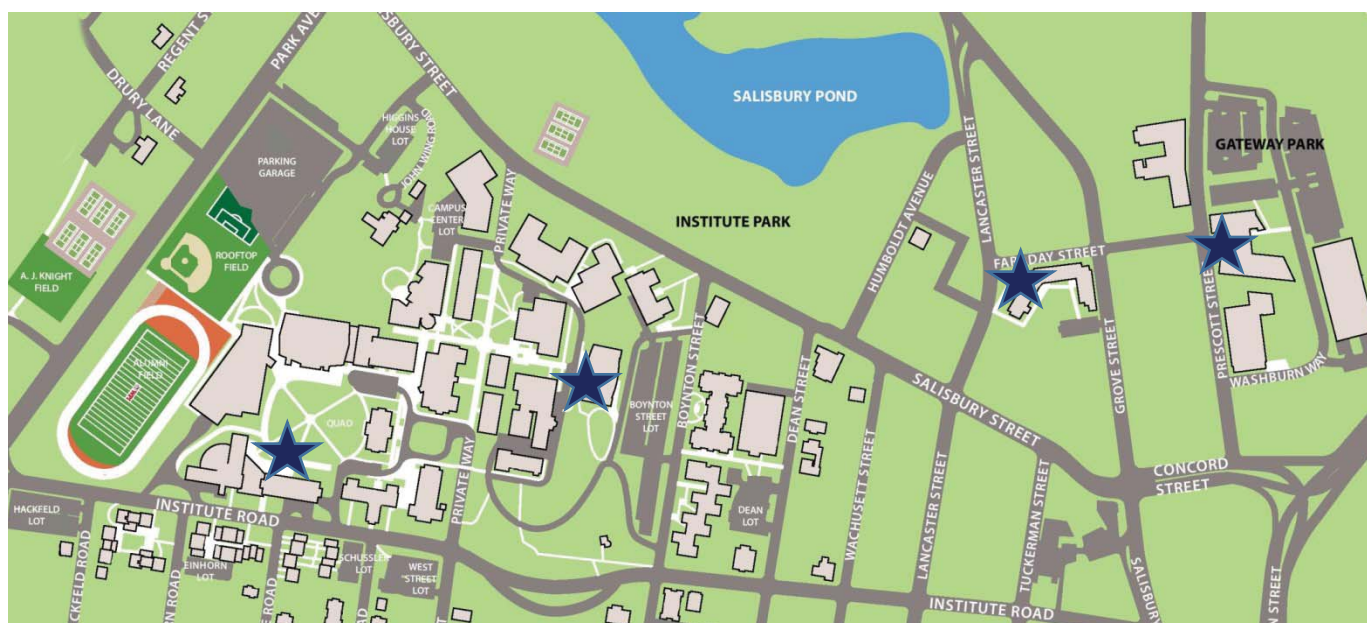


Figure 30: Automated Key Box from On Bike Share

Every time the key box opens, the date, time, and user information are stored in the key box's internal memory. The data is obtained by uploading to a simple USB drive with an administrative PIN.

3. Bike Locations (Number and Placement)

These locations are at areas of a high concentration of potential users. From left to right in xxx below are the locations on the Quad, an area with close access to four of five freshman residence halls and two upperclassman residence halls as well as people using the Quad or eating in the dining hall. The library is on the academic portion of campus which sees thousands of students and employees passing through every day. The next is at Faraday Hall, home to more than 250 students. The last location is at Gateway Park, with over 40 faculty members as well as staff and many graduate students.



4. Bike Locks

The On Bike bicycles have an integrated U-lock.

5. Bike Type

The On Bike bicycle will be used.

6. Number of Bikes

Minimum: 16

Maximum: 31

7. Bike Share Operator(s)

The day to day operations and marketing of the bike share will be run by the WPI Student Green Team. Because maintenance of the bikes is essential for a successful bike share, the Green Team will recruit additional members beyond their current membership who are interested in maintaining the bikes.

Additionally, a faculty and / or staff member serves in an advisory role for the bike share and oversees its operation. While the Green Team members will run the day to day operations, it is important that a supervisor ensures tasks weekly or monthly tasks are accomplished. Additionally, this advisor would serve to maintain continuity of leadership during Green Team officer transitions.

Operations Plan

2-3 Times per Week

- Check bikes for appropriate tire pressure, brake status

Twice a month (or if a problem is reported)

- Upload bike use data from all key boxes

Once a Month

1. Each bike should be fully maintained
2. To do so, have a weekly maintenance time (for example two hours on a Sunday)
 - Each week, pull 4 of the 16 bikes for maintenance
 - Tighten all bolts, brakes, pedals etc.
 - Fix any other issues

When user submits a maintenance request

- Immediately take bike out of operation
- Either immediately fix or hold until regularly scheduled Sunday maintenance

Keep permanent record of bike use and maintenance.

Market and promote bike share.

8. Bike Share Users

The bike share is open to all undergraduate and graduate students, faculty and staff.

9. Checkout Format

This system uses the Ride-and-Return checkout format. A user returns a bike to the spot from which it was taken. A bike is signed back in when the bike is locked on location and the key is returned.

10. Checkout time

The bikes can be signed out for up to 8 hours.

To instill accountability to the users for keeping the bikes safe and returned on time, a fee system is put in place. A way to charge student accounts for late or damaged bikes must be set up.

- 1st Late: Emailed warning
- 2nd Late and beyond: Monetary fine
 - The late fee should be based on the number of hours returned late. If a bike is not returned by 24 hours, an additional charge may be made. If the bike is not returned at all, the user is charged for the full cost of replacing the bike.
- Users are not responsible wear and tear of the bikes, but any significant damage beyond this expected amount is subject for charge.

11. Cost to User

There should be no cost to users in an effort to increase sustainable transportation on the WPI campus. The benefit to the university is the decreased single-occupancy vehicle use. In addition, in order to build up a base of supporters it is important for it to be free to join the bike share. If in the future it is determined a base of users has been established, the possibility of charging a membership fee can be evaluated.

12. Workshop Space and Maintenance

A space to maintain the bikes is required. Though basic maintenance can be done on location, a workshop is required for more in depth maintenance. If a small space is available in building on campus, it would be closer to the bike share location. If not, our contact in the Department of Facilities envisions a space being set aside for a bike storage and maintenance area.

13. Winter Storage Space

The bikes will be stored in a protected space during the winter to protect the bikes from the winter weather. To keep logistics simple, this space is the same as the workshop and maintenance space. There must be room to store or hang the 16 bikes.

14. User Sign-Up, Liability, & Education

Create a website for the bike share to allow users to sign up online. The website should include educational videos followed by a quiz to check understanding. The purpose is to ensure users know how to properly and safely use a bike such as how to use the gears, brakes, seat adjustment, etc. In addition, it should provide information about basic skills to personally check if bike is safe to ride such if the brakes work and all the joints are tight. Finally, the user should fill out and electronically sign a liability form created by the university. In this, the user agrees to be liable for a damaged or lost bike and that the school is not liable for any injury sustained while using the bike share.

A.4 Automated Key Box – Web Based Management Software

This is a fully-automated system using the technology from On Bike Share.

1. Bike Share System

The Automated Key Box system uses technology from On Bike Share including specially designed bike racks with electronic key boxes installed and specially designed bikes. As with the bike corral, the system is characterized by the answers to the essential aspects that follow. To learn how this system works for users, see section 2 and how the bike share operators set up the key boxes, see section 7.

2. Bike Sign Out / Log Method

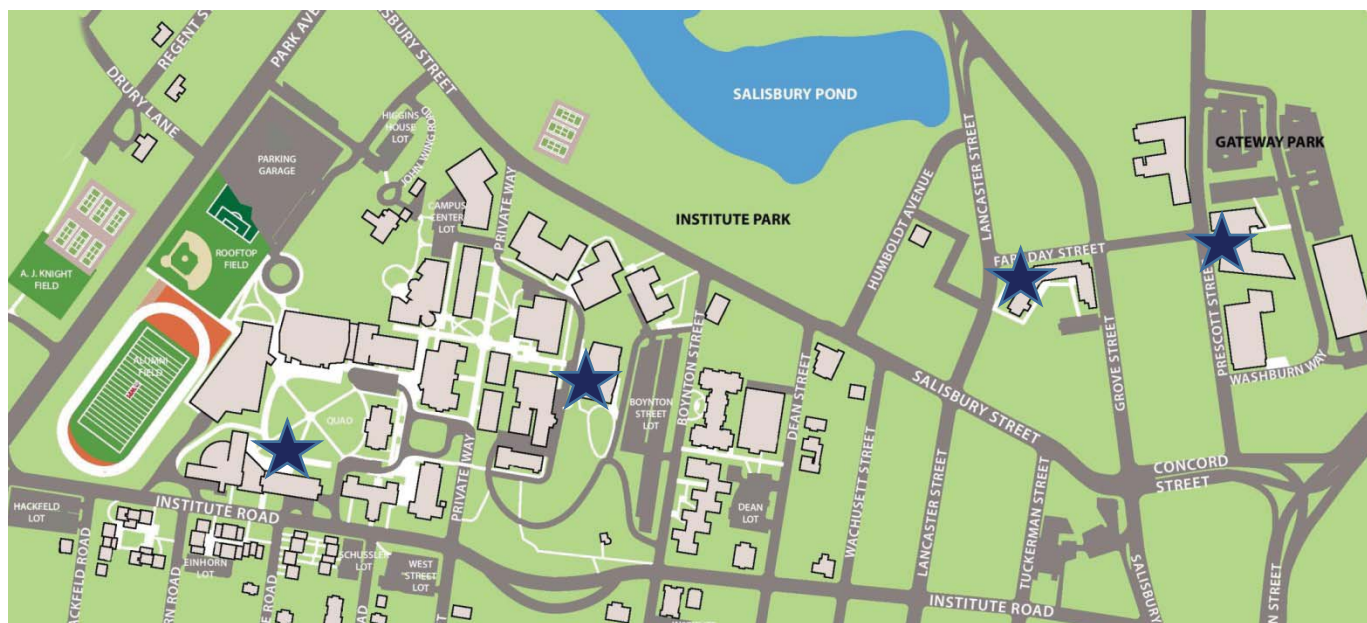
This is a fully-automated system that does not require a bike share location be at a building staffed with an employee. The technology required for sign-out is the key box on the bike rack itself and a smart phone application (app) as seen in Figure 30. The key box has a number pad on the outside and contains the key to the bike locked to that specific rack.

Different sets of 800 randomly generated single-use personal identification numbers (PINs) are uploaded to each box. Once a user has enrolled in the program, he or she uses the app to request a PIN for a specific key box which the user enters to open that key box. The user then takes the key and closes the key box and is free to ride the bike to any location before returning the bike to the same exact rack in an allotted amount of time. Upon check-in, the user uses the app to get a new PIN to open the same box from which the bike originated and return the key.

Every time a user requests a PIN, the date, time, and user information are recorded via the server. This provides real-time, automatic data acquisition. As with the PC-based software the data is also stored in the key box's internal memory as backup. This data is obtained by uploading to a USB drive with an administrative PIN.

3. Bike Locations (Number and Placement)

These locations are at areas of a high concentration of potential users. From left to right in xxx below are the locations on the Quad, an area with close access to four of five freshman residence halls and two upperclassman residence halls as well as people using the Quad or eating in the dining hall. The library is on the academic portion of campus which sees thousands of students and employees passing through every day. The next is at Faraday Hall, home to more than 250 students. The last location is at Gateway Park, with over 40 faculty members as well as staff and many graduate students.



4. Bike Locks

The On Bike bicycles have an integrated U-lock.

5. Bike Type

The On Bike bicycle will be used.

6. Number of Bikes

Minimum: 16

Maximum: 31

7. Bike Share Operator(s)

The day to day operations and marketing of the bike share will be run by the WPI Student Green Team. Because maintenance of the bikes is essential for a successful bike share, the Green Team will recruit additional members beyond their current membership who are interested in maintaining the bikes.

Additionally, a faculty and / or staff member serves in an advisory role for the bike share and oversees its operation. While the Green Team members will run the day to day operations, it is important that a supervisor ensures tasks weekly or monthly tasks are accomplished. Additionally, this advisor would serve to maintain continuity of leadership during Green Team officer transitions.

Operations Plan

2-3 Times per Week

- Check bikes for appropriate tire pressure, brake status

Once a Month

3. Each bike should be fully maintained
4. To do so, have a weekly maintenance time (for example two hours on a Sunday)
 - Each week, pull 4 of the 16 bikes for maintenance
 - Tighten all bolts, brakes, pedals etc.
 - Fix any other issues

When key box becomes low on available single-use PINs

- Generate new list of 800 randomly generated using provided software and upload to the key box

When user submits a maintenance request

- Immediately take bike out of operation
- Either immediately fix or hold until regularly scheduled Sunday maintenance

Keep permanent record of bike use and maintenance.

Market and promote bike share.

8. Bike Share Users

The bike share is open to all undergraduate and graduate students, faculty and staff.

9. Checkout Format

This system uses the Ride-and-Return checkout format. A user returns a bike to the spot from which it was taken. A bike is signed back in when the bike is locked on location and the key is returned.

10. Checkout time

The bikes can be signed out for up to 8 hours.

To instill accountability to the users for keeping the bikes safe and returned on time, a fee system is put in place. A way to charge student accounts for late or damaged bikes must be set up.

- 1st Late: Emailed warning
- 2nd Late and beyond: Monetary fine
 - The late fee should be based on the number of hours returned late. If a bike is not returned by 24 hours, an additional charge may be made. If the bike is not returned at all, the user is charged for the full cost of replacing the bike.
- Users are not responsible wear and tear of the bikes, but any significant damage beyond this expected amount is subject for charge.

11. Cost to User

There should be no cost to users in an effort to increase sustainable transportation on the WPI campus. The benefit to the university is the decreased single-occupancy vehicle use. In addition, in order to build up a base of supporters it is important for it to be free to join the bike share. If in the future it is determined a base of users has been established, the possibility of charging a membership fee can be evaluated.

12. Workshop Space and Maintenance

A space to maintain the bikes is required. Though basic maintenance can be done on location, a workshop is required for more in depth maintenance. If a small space is available in building on campus, it would be closer to the bike share location. If not, our contact in the Department of Facilities envisions a space being set aside for a bike storage and maintenance area.

13. Winter Storage Space

The bikes will be stored in a protected space during the winter to protect the bikes from the winter weather. To keep logistics simple, this space is the same as the workshop and maintenance space. There must be room to store or hang the 16 bikes.

14. User Sign-Up, Liability, & Education

Create a website for the bike share to allow users to sign up online. The website should include educational videos followed by a quiz to check understanding. The purpose is to ensure users know how to properly and safely use a bike such as how to use the gears, brakes, seat adjustment, etc. In addition, it should provide information about basic skills to personally check if bike is safe to ride such if the brakes work and all the joints are tight. Finally, the user should fill out and electronically sign a liability form created by the university. In this, the user agrees to be liable for a damaged or lost bike and that the school is not liable for any injury sustained while using the bike share.

A.5 Program Comparison

Seen in *Table 10* is a comparison of the bicycles for each implementation plan. The

Table 10: Comparison of bicycles for each implementation plan

	Used Bikes	New Bikes	On Bike	Breezer Uptown
Source	Worcester Earn-a-Bike	Bike Shop	On Bike Share	Zagster
Lock	U-Lock	U-Lock	Integrated U-Lock	U-Lock
Gearing	Chain Driven	Chain Driven	Shaft Driven	Chain Driven
Basket	Possible	Yes	Yes	Yes
Reliability	Not reliable	Reliable	Reliable	Reliable
Repaired By	Operators	Operators	Operators	Zagster
Cost	\$0	\$400	\$800	\$1,200

A.6 Cost Analysis and Comparison

Seen in Table 11 is a breakdown of all costs associated with creating a bike share at WPI, accounting for various expense criteria and different potential bike share systems. There are four types of bike share systems we are considering, each with one or more setup options which describe how each material will be obtained. The criteria are broken down into three major sections: one-time costs, annual costs, and cost per bike. In this section, we will discuss the three bike share systems, and each individual cost associated with it.

Table 11: Total cost breakdown for each system

System	Bike Corral		Tech-on-Bike	Automated Key Box - PC	Automated Key Box - Web
Criteria	Earn-a-Bike	New Shop Bikes	Zagster	On Bike Share	On Bike Share
Tools & Materials	\$528	\$528	-	\$528	\$528
Racks	\$2,400	\$2,400	Included	Included	Included
Logo	-	-	Included	Included	Included
On-site Training (Opt)	-	-	Included	-	\$1,400
Est. Shipping	-	-	Included	\$500	\$500
Bikes (16)	\$0	\$6,400	Included	\$16,784	\$20,304
Locks (16)	\$455	\$455	Included	Included	Included
Helmets (16 helmets for bike corral, 100 for all others)	\$90	\$90	\$560	\$560	\$560
Bikes (31)	\$0	\$12,400	Included	\$32,519	\$39,339
Locks (31)	\$882	\$882	Included	Included	Included
Helmets (31) (100)	\$174	\$174	\$560	\$560	\$560
Total Start-up Cost (16)	\$3,473	\$9,873	\$19,200	\$18,372	\$21,892
Total Start-up Cost (31)	\$3,984	\$16,384	\$37,200	\$34,107	\$40,927
Maintenance Cost (16)	\$400	\$400	Included	\$400	\$400
Maintenance Cost (31)	\$800	\$800	Included	\$800	\$800
Software Annual (16)	\$0	\$0	Included	\$0	\$800
Software Annual (31)	\$0	\$0	Included	\$0	\$1,550
Total Annual Cost (16)	\$400	\$400	\$19,200	\$400	\$1,200
Total Annual Cost (31)	\$800	\$800	\$37,200	\$800	\$2,350
First Year Cost (16)	\$3,873	\$10,273	\$19,200	\$18,772	\$22,292
First Year Cost (31)	\$4,784	\$17,184	\$37,200	\$34,907	\$41,727
Subs Years' Cost (16)	\$400	\$400	\$19,200	\$400	\$1,200
Subs Years' Cost (31)	\$800	\$800	\$37,200	\$800	\$2,350

Helmets

Many interviewees expressed concerns with ensuring the safety of the bike share. Some bikes shares require helmet use while others strongly encourage use. In a bike corral, we recommend bikes be handed out on location. When a user signs out a bike, they receive a key to the bike as well as a helmet. For any of the automated systems, helmets could be distributed from a building from a staff member, but it would not be convenient if a user signed out a bike at a location other than the library. At Boston University, helmets are offered free of charge to all members of the BU community to encourage and ensure the health and safety of as many people as possible. We recommend this service be provided for any automated

system at WPI. The helmets are purchased from a non-profit called Helmets-R-Us for a price ranging from \$3.65-\$7.95. This is considerably less than purchasing a helmet from another source. For the 3 automated systems, we have \$560 budgeted for 100 helmets for an average cost of \$5.60 each.

Tools and Materials

Table 12 and Table 13 show the cost breakdown for the tools and materials needs to maintain a bike share. The total cost, at around \$528, is referenced in the total bike share breakdown.

Table 12: Costs of tools needed for a bike share

Tool	Specifications	Number	Unit Cost	Cost
Metric ratchet set	Down to size 6mm			
Standard ratchet set	Down to size 1/4"	1	\$74.99	\$74.99
Vice grip	Small size	2	\$11.91	\$23.82
Screwdriver set	Philips and Flathead	1	\$29.99	\$29.99
Allen wrench set	Metric and Standard; wide size range	1	\$10.68	\$10.68
Spoke wrench	Standard bike repair equipment	2	\$4.59	\$9.18
"Third hand" tool	Standard bike repair equipment	2	\$5.00	\$10.00
Diagonal wire cutter	Diagonal	1	\$6.97	\$6.97
Air pump	Manual	1	\$22.31	\$22.31
Repair Stand	Tripod	1	\$39.95	\$39.95
Tool Cost				\$227.89

Table 13: Costs of bike repair materials

Material	Specifications	Number	Cost/Unit	Cost
Inner tube	Various sizes	20	\$5.00	\$100.00
Spokes	Various sizes; commonly sold in packs of 5	10	\$5.00	\$50.00
Brake/shifter cables	Various sizes; commonly sold in packs of 10	5	\$10.00	\$50.00
Brake pads	Various sizes; commonly sold in packs of 4	10	\$10.00	\$100.00
Material Cost				\$300.00

Bike Corral

The bike corral method is the least expensive method, although it requires the most individual costs for each criterion. We identified two different options for bike corrals, both related to the sources from which the bikes could be purchased. Bikes could be obtained through the volunteer organization Worcester Earn-a-Bike or through a bulk purchase of new bikes from a bike vendor. Both of these options require that the governing student organization of the bike share carry out all of the maintenance for the bikes. The cost of tools and materials is set at \$528 for all bike shares requiring that students running the program do all of the bike

maintenance. The bike corral system requires that new bike racks be installed to accommodate bikes. For 16 bikes, 8 freestanding racks are required to lock the bikes; at an average cost of \$300 per rack, including shipping, this means there is a total cost of \$2,400 to purchase bike racks. Shipping the bikes to a host university is a factor to consider.

For all of these programs, the actual cost of bicycles is the most expensive aspect. As seen in Figure 15, the total recommended number of bikes for a WPI bike share is 16 to 31 bicycles. Using Worcester Earn-a-Bike as a bike source is the best cost-cutting method, though many hours worked are required to obtain bikes, the bikes are free. Buying new bikes for a WPI bike share is another alternative. These bikes could be bought in bulk from a local bike shop. Our cost estimate for new bikes is around \$400/bike. The cost of helmets is \$5.60/helmet, and locks around \$29/lock. The only annual cost for this program is a yearly maintenance budget, for new tools and materials.

Automated Key Box

Both methods for the automated key box system include the cost of tools at \$528. The bikes with integrated u-lock and racks with key boxes are priced at \$1,049 per bike in the PC-version and \$1,269 per bike in the web-version and there is a total shipping cost of \$500. For the web-based system, there is an optional \$1,400 training program, which we have chosen to ignore in our calculations. These bikes have built-in locks, so that cost is not a factor to consider. We budgeted \$560 for 100 helmets. Annually, there is the yearly maintenance budget as well as a cost to use the On Bike Share software for the web-based system. The software fee is \$50 per bike per year.

Tech-on-Bike

The tech-on-bike system, provided by Zagster, is unique to the other systems in that they charge a flat fee per bike per year for complete use of their system. There is no maintenance cost since all maintenance is provided by the company. Zagster provides the locks, bike racks, and bikes. They only require the operator purchase bike helmets which as mentioned we budgeted at \$560 for 100 helmets. For complete use of their system, Zagster charges \$1,200 per bike.

APPENDIX B: INTERVIEW QUESTIONS

B.1 Questions for University Bike Program Operators

Email Interview with Worcester State University Bike Share

11/25/2014

- How successful has your program been?
 - Students are using the bikes and that provides them with an alternative to driving and / or waiting for the bus shuttle to take them to the off-site asking. In that sense, the program has been a success.
- What are the best / most successful parts of the program?
 - A donor found out about the program and bought us an awning and 5 new bikes.
- What are the worst / most unsuccessful parts?
 - We have had a bike break down and don't have the infrastructure to repair bikes readily. . . .Also, there has been a few students who don't know how to use the locks, so a couple of locks have been broken . . .
- Looking back on your program, what do you think could be improved upon?
 - We need more resources, particularly for repairing the bikes if they break down. Also, the system for distributing locks and helmets could be better
- What characteristics did you forget about? Neglect?
 - We didn't neglect anything, but were working from limited resources. We still need a tool station or bike shop for it to function completely correctly. . . . Students have organized a bike club and we are hopeful that they will step up in time and get budget from the student activities funds to arrange for bike repair and or a bike shop . . .
- If had had all the resources you needed, what would you change about your program or how would you arrange it differently?
 - We would have a dedicated shop to repair bikes (it would have an espresso maker in it) and we would have a method to distribute bikes and helmets and locks 24 / 7.
- What resources did you have in starting/running the program? Where were they acquired?
 - Donations, grants, etc. I began this program with the director of residence life and housing. We had a budget of \$1200 and worked with Earn-a-bike to put 5 bikes in play. . . Following this, a donor came forward with money for the awning and new bikes. We will have 5 new bikes out there in spring.
- Who maintains your bicycles?
 - I do.
- How are bicycles stored? Are they protected from weather?
 - We have access to a barn and also storage facility on campus.
- Does the program end for the winter?
 - Yes.

- About how much did the program cost?
 - A donor gave us approximately \$20,000 for the new awning and the new bikes, which will be painted custom with our school colors and bike share logo.
- What was the most expensive part?
 - \$9000 for awning.
- Do you have any statistics on bike use such as rentals per week/year?
 - No. We will be compiling data on usage over the winter.
- Any final comments or recommendations?
 - [no response]

Email Interview with Rochester Institute of Technology Bike Share

12/02/2014

- What are the best/most successful parts of the program?
 - There is very consistent demand for bikes. Our maintenance plan has worked well and the bikes are very safe. The model of having bike checkout and return being handled by staff in the Residence Life office has worked well.
- What are the worst/most unsuccessful parts of the program?
 - We don't have enough bikes to satisfy demand. There are some flaws in how bikes are handled. The primary issue is due to bike checkouts and check-ins being based on the key to each bike's lock. We discovered that it is possible for a student to hand back the key, while keeping the bike locked somewhere other than the rack we expect it to be in. If that bike was overdue for maintenance at the time of check-in, it is possible for a bike to be missing for several days without anyone noticing. The biggest pitfalls of the program are small vulnerabilities in the workflow like that.

Looking back on your program, what do you think could be improved upon?

- We want to improve the program by doubling the amount of bikes we have in the spring. We are also hoping to add another bike checkout location in the spring, as our campus is very long with student housing at both ends. When we started the program, we did not provide all of the equipment necessary to make the bikes street-legal, including bells and lights. We have since added bells and started adding lights, but they add a significant maintenance burden. Another issue we discovered is that we didn't have a plan for storing bikes in the winter. We did end up purchasing a shipping container to store the bikes, but we didn't end up getting it until after the first snow. Finally, we intended to be able to charge students who misused the service or turned in bikes late. Unfortunately, we were not able to work out the logistics of charging student accounts, so we have no ability to enforce our rules.

If had had all the resources you needed, what would you change about your program or how would you arrange it differently?

- Ideally, the bike share would be fully automated, without the need for dedicated checkout stations. Currently our system functions more like a bike library than a share. The ideal model is one in which you can check out a bike wherever you are, ride it to your destination, and leave it there. Currently, maintenance is done biweekly, with half

the fleet being taken offline on Sunday and Tuesday night. If we had unlimited resources, it would be nice to maintain the bikes on a rolling basis, to avoid times when lots of bikes are offline.

What resources did you have in starting/running the program? Where were they acquired? Donations, grants, etc.

- We started with donations from departments within RIT, as well as funding from Student Government. We have also received donations to expand the program from RIT's Board of Trustees.

Who maintains your bicycles?

- The bikes are maintained by student mechanics in the bike shop that was started alongside the program. Long-term, the bike shop will be supporting bikes owned by individual students on campus, as well as selling equipment to riders.

How are bicycles stored? Are they protected from weather?

- The majority of RIT's bike racks, including the one we use for the program, are not weather protects. During the winter, we store them in a shipping container.

Does the program end for the winter?

- Yes, we decided to close the program on 11/15. It will reopen again in the spring.

How much did the program cost?

- The program costs quite a lot. I think the proposal estimates are pretty close to what we ultimately ended up spending. Maintenance is the most significant recurring cost, because it needs to be done weekly for the duration of the program. We found that the maintenance costs were a little higher than expected, because some components on the bikes had a tendency to break, like the pedals.

Other thoughts

- We created a web application to handle the administration of the bike share program. We made that application open source, and would love to see other programs use it!
<https://github.com/ritstudentgovernment/BikeShare>

I hope this information is helpful. Please feel free to reach out if you have any other questions.

Phone Interview with Wellesley College Bike Share

01/30/2015

How your program was created:

- When was the program started?
 - 2012
- We saw there was a previous incarnation of a bike share at Wellesley. Do you have any information on that?
 - No info
- How did you choose to use an outside vendor for the program?
 - Much easier to manage bikes
 - Bikes are sturdier and require less maintenance
- What is the source of the bikes?
 - On Bike Share
- To where do users commonly ride?

- Mostly around campus, also jobs, and to get into town (Wellesley)
- Looking back on your program's implementation, what could be improved upon?
 - Keywatcher doesn't work well
 - Intern doesn't always work out well/too much responsibility
 - Office of Sustainability should have a more of a management role, less nitty-gritty detailed work
 - Need more passionate students to operate the program
 - Working on emails when bikes are overdue, late
 - Students will return keys and not bikes
- If you had all the resources you needed, what would you change about your program or how would you arrange it differently?
 - Making sure management is present after program is created

How your program is currently run:

- Who runs the program?
 - Wellesley Office of Sustainability
 - Office of Sustainability hires an intern to manage the bike share
 - Involves signing out the bikes, checking on maintenance, enforces rules, etc.
 - <http://www.wellesley.edu/sustainability/transportation/bike-share>
- Who is the program open to?
 - Students, Faculty, Staff
 - Only students currently utilize the program
 - Users must sign a liability waiver to sign up to the program
 - Waiver drafted by school lawyers
- Who maintains the bikes?
 - Office of Sustainability
 - Students must file a report that the bike needs maintenance
- How often are bikes maintained?
- What kinds of issues are reported?
 - Flat tires
 - Broken U-Locks: bikes don't lock or unlock
- What type of security or locking mechanism is used?
 - Keywatcher lockboxes; PIN number gives out a key to unlock bikes
 - Users then use unlock U-Locks with keys
- What is the time of allowed use per checkout?
 - 24 hours
- How many bikes are there in the program?
 - Started 15, now 25
- How many locations of bikes are there?
 - Started 1, now 2
 - One at campus center (center of campus), one at resident hall
- Does the program end for the winter?
 - It ended at winter break, will continue in the spring sometime

Overall cost of your program:

- What resources did you have in starting/running the program?
 - Grant from school's "Green Fund"
 - Continuing funds from Office of Sustainability budget
- Is there a cost to the users?
 - None

Overall success of your program:

- What are the most successful parts of the program?
 - Anybody is allowed to use a bike
 - Users appreciate the service, the program is rewarding/good for student life
- What are the least successful parts of the program?
 - Management isn't strong enough
 - Students are not educated enough on proper bike use

Interview / tour, Clark University bike share, Cycles of Change
02/01/2015

How your program was created:

- When was the program started?
 - 8 years ago
- What is the source of the bikes?
 - Worcester Earn-a-Bike
 - University Police "UP" "snip" up bikes every 6 months or so when they see they are abandoned
- Looking back on your program's implementation, what could be improved upon?
 - Streamline some things
 - Might look into a grant to implement swipes
 - Note: When asking for funds, say "this much is for a one-time purchase of tools" and they will be more willing knowing you don't need that much every time
- If you had all the resources you needed, what would you change about your program or how would you arrange it differently?
 - Add card swipe checkout

How your program is currently run:

- Who runs the program?
 - Student group: Cycles of Change
- Who is the program open to?
 - Anyone can use: Students, faculty, and staff
 - There are some faculty that use the program
 - Some grad students use it
- Who maintains the bikes?
 - Cycles of Change
 - Check bikes daily
 - Most common issues: brakes, rims, tire pressure, chains
- How often are bikes maintained?
 - Usually there is one issue a day to resolve

- What kinds of issues are reported?
 - Most common issues: brakes, rims, tire pressure, chains
- What type of security or locking mechanism is used?
 - Go to student center desk, fill out log to sign out, show ID for workers to check to make sure you are part of the bike share, get a key for a certain bike and lock, ride
- What is the time of allowed use per checkout?
 - Return by midnight
- How many bikes are there in the program?
 - Have ~24
 - Have 12-14 working at all times (currently 15)
 - Put out 10 every day
- How many students use the program?
 - 150-200 signed up. When asked if people sign up but don't use, they said not really. Only people who actually sign up are those who will use it at least occasionally.
 - 20-25 people use every day
- To where do users commonly ride?
 - Groceries
 - Weekend travel
 - Internships
 - Do group rides (Saturdays at 11am)
- How many locations of bikes are there?
 - One (outside student center)
- Does the program end for the winter?
 - Yes: Around November

Overall cost of your program:

- What resources did you have in starting/running the program?
 - Got all the bikes from Worcester Earn-a-Bike
 - Currently \$800 per year from student council
 - Now not much need for money: subsidize parts to sell
 - Used to have ~\$1200 per year: almost all or all was used up
 - Particularly buying tools
- Is there a cost to the users?
 - No it is free for all users

Overall success of your program:

- What are the most successful parts of the program?
 - Seeing people biking around Worcester on a bike with a Clark Bike Share sticker
- What are the least successful parts of the program?
 - Sustaining membership and keeping excitement

Additional Details

- Cycles of Change
 - Goals of the program: promote biking and sustainability

- In winter, group focuses on increasing campus awareness since bike share is closed
- RA programs in the dorms: “How to fix a flat”, forums and discussions
- Goal to have one Cycles of Change member at each monthly CollabLab (meetings on sustainability) meeting
- Want to have advocacy workshops: how to ride safely in Worcester and cities: how to use hand signals, turns, where to stop at crosswalks
- Positions in club: Leader to promote throughout the school and Worcester, contacts person (organizing events with other organizations), mechanics, treasurer for all forms and events
- Have 9 helmets (10 bikes in use)
- Waiver: Online before joining the bike share, must check the box “I agree to all above conditions...”
- Website has ~4 minute orientation video
- Long-term goal / project: have app, tech to input where want to go, time to ride and it gives you traffic, “niceness” of the ride, and gives bike route

Email Interview with Tufts University Bike Share “Tufts Bikes”

02/23/2015

- How successful has your program been?
 - Tufts Bikes has been extremely successful in the past years. We have been especially successful because students are aware of this program. This may be due to our branding on campus. We had a very cool logo made for us a couple of years back and we distribute stickers of the logo around campus at different events. You see many students with the sticker on their computer or on their water bottle.
- What are the best / most successful parts of the program?
 - The most successful part of the program is our mechanic arrangement. We have a small shop where we can store our tools and fix the bikes. We plan many activities, but the most essential part of Tufts Bikes is to keep the bike share running.
- What are the worst / most unsuccessful parts?
 - The most unsuccessful part of the program is the frequency of how often the bikes need repair. We have some bikes that are up to 6 years old, and these were low quality when we bought them. So naturally, they tend to get damaged often. We are there to fix this problem though.
- Looking back on your program, what do you think could be improved upon?
 - We could improve in having had spent our money on better bikes initially.
- What characteristics did you forget about? Neglect?
 - We neglected the fact that not too many people on campus are interested in learning how to repair bikes.
- If had had all the resources you needed, what would you change about your program or how would you arrange it differently?

- Due to difficulty finding students who are interested in becoming bike mechanics, if we had all the resources, I would make sure that these mechanics would be compensated for their work. Our mechanics do not get paid anything.
- What resources did you have in starting/running the program? Where were they acquired?
 - When the program started, we bought 12 bikes and we bought the necessary tools to maintain the bikes in good shape.
- About how much did the program cost?
 -
- What was the most expensive part?
 - The most expensive part is acquiring the bikes.
- How did you acquire your bikes?
 - We made a deal with a local bike shop and bought in bulk.
- Why did you choose to buy new bicycles instead of refurbished bikes?
 - There is no exact reason. We just saw it as more convenient to order in bulk if they were new.
- Who maintains your bicycles?
 - It is up to the club (Tufts Bikes) to find students who want to learn how to repair and maintain bikes. We maintain the bikes. We have 3 two-hour shifts throughout the week. And we currently have around 9 mechanics.
- How are bicycles stored? Are they protected from weather?
 - We have two locations where bikes are stored. One at the campus center and the other at the library. These are bike racks with a roof. We have 15 bikes at each location and each bike is locked individually to the rack. The keys can be acquired at the library after students sign a form.
 - They are not protected from the weather, nothing more than protection by the roof.
- Does the program end for the winter?
 - We do close for the winter and for the summer since we do not have any mechanics on campus.
- Do you have any statistics on bike use such as rentals per week/year?
 - We do not have any actual statistics for the bike usage.
- Any final comments or recommendations?
 - [no response]

Phone Interview with NYU Bike Share

03/03/2015

How your program was created:

- When was the program started?
 - 2008 under a “green grant”
- What was the inception of the program?
 - Increase biking on campus
 - Sustainable transportation

- What is the source of the bikes?
 - First bikes: bulk order of new bikes paid for by Green Grant
 - Last year: abandoned clipped by campus police and donated to the program
- Looking back on your program's implementation, what could be improved upon?
 - New bikes were not great bikes
 - Really heavy
 - No hand brakes, only pedal brakes
 - Put research into what kinds of bikes students want
- If you had all the resources you needed, what would you change about your program or how would you arrange it differently?
 - Analytics system is subpar
 - Better data collection
 - Marketing
 - Currently, there is only a shout out during welcome week and posters around campus
 - Thirteen bike stations

How your program is currently run:

- Who runs the program?
 - Students working for the Sustainability Office
- Who is the program open to?
 - Anybody NYU
 - Mainly cater toward students
 - Many locations inside residence halls
- Who maintains the bikes?
 - Users submit an online form if there is a problem
 - The workshop is maintained and all repairs are done by student employees and volunteers.
 - Few people with experience
- How often are bikes maintained?
 - Depends on time of year, once a week in winter, more in summer
 - Summer and spring are busy
- What kinds of issues are reported?
 - Minor problems
 - Loose chain
 - Seat post slips
 - Half have bigger problems
 - Breaks
 - Flat tires
- What type of security or locking mechanism is used?
 - Bikes are in res halls
 - U-locks
 - Users take them on rides
- What is the time of allowed use per checkout?
 - 10am-10pm

- Building hours
- What kind of locking mechanism do you use?
 - U-locks
- How many bikes are there in the program? How many did you start with?
 - 45 currently
 - 3-4 per station
- To where do users commonly ride?
 - No answer
- How many locations of bikes are there?
 - 13
- Does the program end for the winter?
 - No

Overall cost of your program:

- What resources did you have in starting/running the program?
 - [no response]
- Is there a cost to the users?
 - Free
- \$14,500 grant
 - Yearly budget is less
 - Goes toward repairs

Overall success of your program:

- What are the most successful parts of the program?
 - Variety of bikes
 - Users feel accountable for individual bikes
 - Responsibility for users
 - People like the variety, choose one bike that is “theirs”
- What are the least successful parts of the program
 - Not knowing that the program exists
 - System for knowing what the problem is could be better
 - Riders currently tell RAs there is a problem
 - Vague info on what problem is if there is a mechanical issue
 - Wastes time currently

Phone Interview with Sustainability Coordinator, Skidmore College

3/13/2015

How your program was created:

- When was the program started?
 - Summer of 2014
 - History: bike share volunteer run program
 - Evolved quite a bit over the year

- It looks as if you used the company On Bike Share to start your program. Why did you decide to use their products? What are the advantages to On Bike Share? What are the disadvantages?
 - Why on bike: affordable: not renting bicycles on a monthly rate
 - Other schools do pay a monthly rent
 - One up-front cost
 - Nice for us had the money, allowed us to get it done and now own them as well as lock boxes
 - Can expand - is scalable
 - Currently there is one bike hub
 - Would be easy to move some bikes to another location or in the future buy more bikes and lock boxes to continue to scale up
 - Convenient process
 - student gets pin and has access the rest of the year
 - Able to track bikes through data collection
 - Know who is taking, when bringing back
 - Pretty new for company On Bike Share: they have had some hiccups
 - If choose On Bike, probably learned from some of the hiccups over the last year
 - Disadvantage: tracking:
 - Software not extremely intuitive and can get complicated
 - Some students are not using bikes the way they should
 - Relies on people bringing bike out and bringing back to same location
 - If students don't to correct spot, can get tricky
 - Biggest challenge right now
 - On Bike is coming to install some new software
 - not charging - since had some issues
 - Lock boxes sent back to California
 - Rep is coming to install new software - very responsive to issues
 - Have PC based system
 - New software will allow a more web based
 - Cannot get data off the web
 - Have to go to bike racks to upload data
 - Infrastructure issue - don't have wiring to the location
- I believe had conventional bike share before On Bike Share. Can you tell me about the differences between the two and why you switched?
 - Switched for few reasons: used to have bikes that had were not made for bike shares: maintenance issues
 - We knew needed new fleet of bikes
 - Library checkout system:
 - Worked for most part: but so many different staff, sometimes rules did not get passed along to every employee: confusion over what the checkout process is.
 - Such as what do you do with maintenance request
 - Some miscommunication

- Overall, became a burden for the library - so many players involved so many communication channels -
 - Since we were already getting a new fleet - just go all the way to On Bike's program.
 - Program does get used quite a bit - have to stay on top of all the data and is all organized
- Looking back on your program's implementation, what could be improved upon?
 - Having a clear understanding of the new software - wasn't super intuitive.
 - Also we implemented it early on in On Bike share's service. Part of Dynamic bikes, On Bike is newer sector. Some of the software and hardware were not exactly up to speed.
 - They have been doing it for businesses - universities gets used quite a bit, higher usage.
 - They have probably learned quite a bit.
- If you had all the resources you needed, what would you change about your program or how would you arrange it differently?
 - Would try to make web based program. Find a way to wire all of the lockboxes to get data in real time, Adding another bike rack or racks in different locations. would be nice if web based to add more racks-
 - need to hire a second bike manager
 - Finding some way to make helmet rentals more accessible
 - Have it in sustainability office - not convenient since not next to bike racks
 - How are you offering helmets that have?
 - Some sort of locking mechanism for helmets next to bikes?

How your program is currently run:

- Who runs the program?
 - Myself (Levi) sustainability office and a hired student as a work study - Emily Durante. Helped lead the charge for the new bike share. The two of them doing all data collection
- How are the bikes maintained?
 - Same two people - a couple times per week - check tires, brakes, as long as all fine, don't need to do too much. Once in a while, other major issues 0 take out of circulation. Keep maintenance schedule to keep track of which bikes have been fixed.
 - Every few weeks, tighten nuts and bolts - at least once a month each bike is taken out and looked
 - Bike shed: "Bike repair kit" several tools, have acquired tools over the years.
 - Bike stand for more intensive work. tubes, brake shifter cables, bike pumps
- What type of security or locking mechanism is used? Any problems with this? If you use the On Bike Share key boxes, have you ever had the issue of users returning a key, but not the bike?
 - Haven't had that issue for the most part - are able to track. If someone does open lock box and don't see a key. They will email us and say there was no key. Look back and see who had the key.
 - They had keys breaking, snapped - on bike tried to use different keys, still run into broken keys.
 - Might be kicking it if near pedal area.

- student will throw broken key into box and then they will track
- Locking into different lock system. - Will be changing to different locking mechanism. On Bike tried new keys. Thinking about own U-locks.
- New Distribution- will still put keys in lock box. Will know exactly who it is that steals a key.
- What is the time of allowed use per checkout? If so, how is this enforced?
 - 5 hours - Started summer of last year: Had 24 hours - found people were treating them like their own bikes, weren't being shared.
 - About 1 mile from downtown: enough time to get downtown and get back without feeling rushed. Seems to work well
 - Def have students who don't return in time. If see they had it longer: will send email and say need to bring back on time or will be charged
- How many bikes are there in the program?
 - 15 in circulation - keep 5 in the bike shed for future expansion, if bike out of commission, can swap out if needed.
- How many locations of bikes are there? How did you choose those locations?
 - Outside library - most central location and visibility - tours that go by there-another visual to showcase sustainability.
- Does the program end for the winter?
 - Yeah - take bikes out once snow starts to fall - so much salt on the ground.
 - Open again weather dependent - week after spring break - doesn't look like that will happen. Will keep out to Thanksgiving.

Overall cost of your program:

- What resources did you have in starting/running the program?
 - Had grant had received and money was needed to be spent by certain date - wrote proposal to them
 - \$22,000 - for 20 bikes ,20 lockboxes, 3 5-bike racks
- Is there a cost to the users?
 - Free to users. All can use as well as visitors: special programs in the summer as long as over 18 and can sign your own waiver and have Skidmore ID. Dancers from all over the world and summer camps - get an ID - get connection to bank account.

Overall success of your program:

- What are the most successful parts of the program?
 - Awareness - people seem to love the program - get people involved in sustainability and healthy transportation
 - Highlight for campus tours
 - Fun way to get people involved in sustainability initiative
 - Lots of people using for different things - people want this , high demand
 - One struggle: lack of awareness for sustainability - this is high visibility
- What are the least successful parts of the program?
 - Time consuming - any program learning curve. Students don't use bikes the way they should. Could take time to track down bike.
 - Never lost anything yet, but takes some time to do some digging.
 - More time than expected
- Different uses: to and from class on different sides
 - Recreation

- Errands: groceries downtown
- Staff members for lunch hour to get out of office
- Used by good range of people for variety
- Do you have any final comments or suggestions for someone looking to start a bike share?
 - Start slow
 - If don't have bike share already - find a way to start more ad hoc - work with library to see if there is a demand.
 - Were confident spending money since knew there was the demand
 - Continue to grow as deemed.

Phone Interview with Zagster Bike Share Company

03/10/2015

Other schools: Yale University, Duke University, California State University East Bay, Santa Clara University

- How does a program with Zagster work?
 - Duke-last year at a similar point as us- had manual program: Bike Corrals
 - Users had to go down to res hall, sign out with staff member get bike for 24 hours
 - Used repurposed abandoned bikes
 - Risk for university - risk management team at university shut down the program
 - Students wanted to get a bike share back on campus
 - Any faculty, student, staff - use mobile app on phone to sign out
 - On app, type in bike number you want and get access
 - Receive the pin number to unlock the box attached to the back of the bike.
 - Open box and get the key for the U lock.
 - At end of rental, return to any station around campus
 - Duke - interested in making it easy working with one company (All very similar goals to WPI!)
 - Goals: sustainability - carbon neutral by 2024
 - Getting single occupancy vehicles use off of campus
 - Want to push cars to the periphery of campus
 - Organic move west everyday
 - Packed buses / shuttles
 - Students complain to admins - though doesn't make sense for buy and operate new shuttle that is empty most of time, only filled at peak hour
 - Need another option for place where shuttle runs
 - Cost: top companies Samsung and General Motors, have free for employees
 - Universities: common for \$20 (Duke)
 - Unlimited rides up to 3 hours
 - Any money charged is returned back to university
 - Bike locations

- All tech on the bike
 - At duke: 15-20 bikes at each location
 - Can set up any number of bikes at any station
 - Air pump included
- Locking mechanism
 - Student - app: gets PIN for key box, use PIN to get key out, free to ride anywhere
- Signing back in
 - Must hit end ride on the app
 - Zagster manages whole project
- Have mechanics take care of bikes
 - Weekly or biweekly basis
 - Business arrangement with admin
 - Zagster has this service for this amount of years
 - Replaced standard use: covered
 - Replace at min every 2 years
 - If student rides, doesn't lock up and stolen: follow up with rider
 - Have some insurance: pay a little more to cover all lost bikes if theft does occur.
- Is it possible for user to return key without returning bike? How to solve this problem?
 - Not asked
- Recommendations for different locations? What distance apart?
 - Not asked
- How is data collected?
 - Rebalancing: major metropolitan : Hubway: full time employees moving things around
 - Zagster much more affordable
 - Rebalancing not as much of an issue
 - Data given to administrators to program
 - Account manager: has conference calls with admin - identify students not using correctly
 - Can be viewed by admins at any time
- Is there the opportunity to expand after the initial installation?
 - Yeah absolutely: happens a lot.
 - Some campuses start with 50 bikes, knowing could use more over time
 - Can sign amendment increase from 50-60
- Is it possible to get a cost estimate?
 - Not answered
- What organization is needed / manpower is needed on our end, at WPI?
 - Almost none
 - Zagster will consult on this pro
 - Duke: met with student government, sustainability official
 - Opinions
 - Cost, terms made sense

- Once figure out these, logo,
- Run completely by Zagster
- Ideal for administrators
- Know that company is professionally taken care of
- Always looking for involvement
- Community manager: opportunities for marketing, awareness, usage up
- Duke:
 - Repurposed used bikes considered a risk for university -
 - Construction / renovations caused program to be moved to different locations because a bike corral must be tied to locations with staff.
 - Decreased participation
 - Bike corral system shut down
 - Interest still present: new program with Zagster
 - Dozens of people signed up before program officially started
 - 150 following week

Phone interview with On Bike Share

03/13/2015

- Difference between PC based and Web based?
 - Would you want to assign PINS or use smartphone each time
 - PC
 - Everyone gets a unique code
 - Simpler approach than web based - simple to install, generate codes load to key boxes. Could generate a preset list of codes and install then just assign
 - Users don't need a phone to use the program
 - More work for the administrator if they want weekly activity logs - more manual trips to upload the data
 - If people signing up and want to get rid of people every few weeks.
 - If put bikes in front res hall
 - Only need activity logs as audit trail if bike is broken.
 - Can use ID number
 - Software: how many codes want to generate, how many digits (500 6 - digit codes) or can change these codes.
 - If student wanted ID number - could do that. Caution against bc if someone knows their ID number - vulnerability.
 - Or could give them a business card with the random code and they can stick that in wallets.
 - Infrastructure: anywhere you put a bike rack
 - Web
 - More capabilities and billing options
 - Needed to charge people
 - Wanted real time data on who is using bikes and when

- More access control - admins can shut people off any time they want to. If users log in to get code, they can't get a code. Have to request it through the server
- Infrastructure: same -
 - Admin runs on PC - generating bunch of codes for each key box - use USB drive to upload codes to key boxes (800)
 - Each key box has different set of 800 PINs.
 - User signs digital waiver - username and password.
 - Click on icon in software.
 - Software gives code
 - Return the bike, request another code. Users log into server each time. Get real time data on the server.
 - When low on PINs, software will say: you are down to 20-40 codes, depending on how often bikes used: 3-4 months. Becomes a normal process - people inspecting bikes and people checking batteries. Could upload at this time. LED indicators will let you know - blinks a certain way if batteries running low. Lithium batteries: 15 year shelf life - 8000 open / close cycles. Don't replace if don't need to
 - Still onboard memory that retains memory.
 - External battery pack - admin code to open up and change battery
 - No special training required - very simple Energizer ultimate lithium - recommend using because they have such a good service life. Maybe 1-2 times per year. Set of 4 = \$6.
- How do you want to set it up?
 - Skidmore - each student has access code
 - Switching over to the web based.
 - Option - can still give out assigned PIN.
 - Web flexibility - can do it either way
 - Advanced a little more expensive - IT does not need to be involved! hosted application - like any other app
 - Little more work to set up front
 - Looks professional - set up program page
 - On Bike gives document with standard data with program description - liability release, Has a map of geo marks with all locations. App shows the locations. Can be customized.
- On Bikes: can modify gear ratio based on terrain
 - 7 - speed Shimano internal gearing system
 - If prefer to have extra help, On Bike can gear down. These bikes won't be as strong on the high end shift it down
 - Helps with hills - if people are struggling on the bikes, they can be adjusted
- How is Web based able to allow users get 1 time pin using smart phone if the key boxes themselves do not require internet connection?
 - Preset one-time use random codes on each box

- Is it possible for user to return key without returning bike? How to solve this problem?
 - “Non-remove key feature” - key stays in until bike attaches
- What prevents one from typing PIN opening and closing box? Walking away with bike?
 - Next person comes and gets the code, but there is no key. They hit the report problem on the app. One problem in the app is no key in the box. Admin gets notification.
 - Would have the people on record that used the bike previously.
 - Ride and return - bikes go back to where they were taken out - no need for bike balancing.
- Recommendations for different locations? What distance apart?
 - Not asked.
- To keep log, recommend collecting data daily/weekly?
 - If PC based, whatever you want.
 - If Web based - all automated.
- Does the key box come separately from the rack?
 - Key box need the mounting plate.
 - If so, can the key box be attached to an existing rack? If so, can key boxes be purchased separately?
 - I think I found one needs to purchase 10 bikes / locks, then can purchase more?
 - Can offer regular bike racks, but no, you cannot just buy the key boxes.
- Helmets? Best way?
 - Depending on require or recommend
 - State of Massachusetts: not required over 14
 - Have vending machines - spend more on this entire 12 bike system
- Skidmore issues
 - Broken keys - How did you solve this?
 - Changed both the key and lock location
 - Bikes that Skidmore has: standard brass key - down by where pedals are in vulnerable spot, softer key
 - Now thicker - copper and nickel much stronger
 - Moved lock location - through rear wheel further behind away from pedal
 - And now smaller key
 - And include additional blanks with the system if you need more keys
 - Software - Upgrading the software? What is being changed? Would this updated software be included in all new systems?
 - Not asked.
 - Web System would only give code for number for the rack it was taken out
 - PC based: could happen where student could return to wrong rack
- Side note: With On Bike Share - can set up like the bike corral system
 - Integrated locks
 - Can use these bikes from security

- Consumer grade lock - someone could
- Integrated lock - cannot remove key until bike is locked
- Know when key is returned that the bike has been locked
- \$800 per bike - key cabinet that has the keys stored - only the librarian has
Access to the keys: uses the master.
- Low maintenance since internal gearing.
- Affordable -
- Can get cheap bikes - not many commercial grade bike share bikes
- Safety, reliability, convenience, security - integrated lock with non-removable key feature
 - Level of security that not found elsewhere
- Interested in working with us

Interview with Zagster Bike Share Company

04/09/15

Other questions

- One-way program vs round-trip program
 - Does someone need bike to get to and from (live in place too close to drive, too far to walk in convenient amount of time: bike share)
 - One-way (Duke, Cal State U East Bay): Rent bike from 1 station to next?
 - Ride to library - not imperative to get back on bike
 - Our issue: rebalancing issue
 - Round-trip (Yale): Rent bike from a station use, and bring back to next station?
- Is the late sign-in fee optional?
 - yes: will make sure it makes sense: most important thing is that the program works
- Can the 3 hour sign out time be adjusted?
 - Varies by partner - apartments: don't charge fee usually
 - Corp: employee happiness, efficiency, promote active lifestyle, benefit of employee
 - Colleges and city: makes sense for pricing so have "skin in the game"
 - Avoid hogging them or leaving around.
 - Act as consultants with university for reason
- WPI: Anticipate movement from residence hall to main campus
 - Would need station at both places to handle bikes
 - Always over budget the rack space to accommodate over crowding
 - If 6 bike station: would want 10-12 racks to account bikes from other stations
 - Would need empty spaces on main campus at night,
 - Say 6 bikes at each location. Would you have room for 12 bikes on the main campus if the 6 bikes from Faraday were all taken to campus?
 - Fleet maintenance operations: design a rack system that allows students to park bikes when get there. If is the case: quite a lot of rebalancing.

- Bike: able to take on hills? What else can you tell me about the Breezer Uptown?
 - Fuji - 7 speed - majority of able bodied - climb a hill
 - lightweight, well balanced
- Helmets
 - What methods do the universities have for distributing helmets? 1) Do they offer them for sale, maybe at a subsidized price? 2) Do they distribute them at the stations somehow?
 - A lot of partners: have discount through Bern - they buy in bulk - just had a corporation purchase 500 helmets: distribute to the employees. Zagster handles the logistics - facilitates the purchase
 - Significant discount with Bern - \$49.99 helmet discounted to what? "Huge Discount"
 - ~30%
 - Zagster.com/helmetorder
- What technology must be installed? Regular bike racks, but how is it known bikes have been returned to the proper location? Power / internet requirements?
 - Geo sensing - need power to station.
 - Geo sensing box
 - Could install a battery system
- If program closes for the winter, would the bikes be stored on campus or would Zagster store them somewhere?
 - Best if WPI allocates space then Zagster helps with launch and re-launch - breakdown of bike stations
- Estimated Costs
 - Start-up and annually
 - Duke was \$60,000 for 50 bikes
 - For a year upfront
 - Structure: include bike use, hardware, software (app), all operations and maintenance wrapped into monthly price per bike.
 - Either pay monthly or ideally a year or so in advance or upfront.
 - High end : \$120 per bike could be lower
 - Change: process for installation
 - Special logistics requirements
 - Before sit down with finance team

B.2 Questions for Local and Regional Officials

Interview with City of Worcester Planning Board - Director and Sustainability Project Manager
02/06/2015

City advocacy of bicycling

- Is biking a priority item for the city of Worcester?
 - Yes, interest in changing the layout of Worcester streets to include bicycles
 - Complete streets: universal accessibility for all travelers on streets.

- Think about all potential users and design for them
 - Shoppers, walkers, parking, bikers, horses, buses
 - About more than just cars
- The city of Boston has an appointed position for a “Bike Czar,” who is responsible for creating greater bicycling awareness, infrastructure, and overall interest in the city. Are there plans to have a “Bike Czar” in Worcester or anyone with a role similar to this? If not, why not?
 - No bike czar currently, and no plans for one in a city such as Worcester
 - The department is more involved in planning
- What ways (if any) is the city working to increase bicycle use? Are there city employees who are specifically charged with doing this work? Who?
 - Incorporating bike lanes and infrastructure in canal district
 - Interest in bike share (Clark, WSU)
 - Expand beyond colleges
 - Sharrows have been installed on Lincoln St. and May St.
 - Making investments in biking, the city is “catching up” to other communities
 - Organizing the Worcester segment of the Blackstone Trail project

Current state of and plans for infrastructure related to biking in Worcester

- What resources are allocated toward improving bicycle infrastructure?
- What kinds of bicycle infrastructure are being developed? Bike racks, bike lanes, etc.
 - No official policy, trying to create such ordinances
 - Incentives:
 - Just passed “overlay district” ordinance
 - Incentive to increase bike parking
 - Downtown and commercial corridors
 - Includes 5% of the city’s land, from Highland St. to the Clark area
- Specifically, what future projects are planned in the area surrounding WPI? Key areas include:
 - Park Avenue (grocery shopping)
 - None
 - Highland Street (restaurants and personal transportation)
 - None, possibly shared lane markings (small area to work with)
 - Look at parallel streets and cross streets for bike options
 - Salisbury Street (personal transportation)
 - Main Street (restaurants and shopping)
 - Major reconstruction
 - 4 lanes to 3 lanes with a center turn lane
 - Free up space for bikes
 - Bicycles are an issue that is being considered
 - Public meetings coming up
 - Lots of bike traffic around Chandler St.
 - Alley between WPI and Union Station
 - Attention is focused on Main Street
 - Blackstone

- MassDOT-run program
 - Cycle track between Blackstone and Union Station
 - On-street bike lanes on Quinsigamond Ave., taken care of by city
 - Connecting to a Blackstone Valley visitor center
 - The City is working on the Worcester segment
- Final Thoughts:
 - Could grow into greater than campus system
 - Possible municipal component to the bike share system, which would include the entire city
 - Improving bike parking, CMRPC has grant to install facilities

Interview with CMRPC and WalkBike Worcester

02/19/2015

- Is biking a priority item for the city of Worcester?
 - Not traditionally; Worcester is a small city, small resources
 - Not progressive in general, but the past few years have been encouraging.
 - No push for change, but there is opportunity
- The city of Boston has an appointed position for a “Bike Czar,” who is responsible for creating greater bicycling awareness, infrastructure, and overall interest in the city. Are there plans to have a “Bike Czar” in Worcester or anyone with a role similar to this? If not, why not?
 - No, Worcester is not at a point yet to have a hired position for coordinating bicycling in the city
- What ways (if any) is the city working to increase bicycle use? Are there city employees who are specifically charged with doing this work?
 - No city employees do this work; WBW, trails and recreational bike groups exist
 - The City is, however, increasingly more involved in sustainability and biking
 - DPW (has a staff person involved in biking), Police Department
- Current laws / rules regarding new roads / repaving and making them bike accessible?
 - Active (or Complete) Streets are advocated, but no official rules
 - Regulations are under development from the MassDOT
 - Highland St and Lincoln St will both have sharrows
 - This is an unofficial rule/law, but encouraged as a good practice.
 - Healthy Transportation Compact
- Current laws / rules for new businesses installing bike racks? Others?
 - CMRPC’s Bicycle Rack Program is under development at this point, it will only supply bicycle racks to municipalities or public agencies, not businesses. A pool of money will be distributed throughout the region, it will be used to reimburse the cost of the bicycle rack, not the installation.

Current state of and plans for infrastructure related to biking in Worcester

- What resources are allocated toward improving bicycle infrastructure?
 - No specific resources allocated toward bicycling, but part of some city infrastructure improvements. Check with the DPW
- What kinds of bicycle infrastructure are being developed? Bike racks, bike lanes, etc.

- Sharrows mostly , though painted bike lanes are also in development
- Specifically, what future projects are planned in the area surrounding WPI? Key areas include:
 - Park Avenue (grocery shopping)
 - No current plans
 - Ideally a median would be added; cut down on speed
 - Highland Street (restaurants and personal transportation)
 - Sharrows will be installed as per state guidelines
 - Salisbury Street (personal transportation)
 - Detection loops for bikers detect presence of bikers
 - Main Street (restaurants and shopping)
 - Large federally funded project in the Central Business District; School St. to Austin/Myrtle Streets
 - Shrewsbury St (restaurants)
 - Alley between WPI and Union Station
 - Plans to install bike lanes on Elm St.
 - Blackstone Valley Bikeway
 - Stretch connecting to Union Station in the works
 - Segment behind Walmart (along Route 146, Millbury St) almost done
 - Segment behind Union Station will be done within 5 years
 - Federally funded
 - Handled by the state, deals with bridge changes
- WalkBike Worcester - Specifics of advocacy
 - History
 - Started in 2011
 - Outgrowth of public health program
 - For what types of things do you advocate? (Awareness, safety, improved infrastructure, etc.)
 - Advocates safety and enjoyment of biking and walking in Worcester[K7]
 - Advocates connectivity to important destinations in and around Worcester
 - With what have you been involved recently?
 - Monitoring development of the Main St. project
 - Monitor state level projects (Blackstone Valley Bikeway)
 - Attend road safety audits, follow national trends, better biking in Worcester
 - Involved with the East Coast Greenway Alliance
 - Sponsor events, community rides, the cemetery ride for example
 - Are there key individuals / bike advocates in the city with which you have worked the city?

Perception on biking and government involvement in Worcester

- What challenges exist to biking in Worcester?
 - Topography
 - Climate

- Attitudes, aggressive drivers
- Bad pedestrian behaviors, bike behaviors
- Lack of knowledge of the rules of the road
- What assets does Worcester have?
 - Somewhat distinct neighborhoods that have different characteristics
 - Large but not huge
 - Nice city with a big sense of community
 - Amount of university students
 - Campuses generating foot traffic downtown, some retail traffic

Interview with Worcester Earn-a-Bike

03/30/2015

Worcester Earn-a-Bike: Specifics of advocacy

- History
 - Matt: 2008 volunteered a couple times: went to Clark (freshman)
 - Fire at building, moved, joined sophomore summer
 - Started ~2003
 - Modeled after Bikes Not Bombs - a much larger org.
 - Focused on econ development
 - Focused on youth earn-a-bike program
 - This idea pulled for the Worcester
 - Worcester Earn-a-Bike - started for youth - then found need for all to have bikes
 - Idea: can give youth structured time, empowerment - building something for themselves, get bicycle at the end
 - Bike gets kids in, programming in middle addresses deeper issues
 - Worcester Earn-a-Bike started by 3 guys, still involved in Woo biking
 - Originally at MLK center: Chandler & Park
 - Now: 4 King St - Community Center - collective (owned by all who rent) fire 2008, temp location, now back
 - Worcester Earn-a-Bike = volunteer only org.
 - Sometimes grant for hiring someone in summer
 - 2009 - kept since: Women & Trans Night: - time only for those individuals to use shop. Called "Femme night/shop"
 - Last year: Youth Shop - 17 under
 - Kids bike sale every summer - 9/10 and under - too young to work on bikes themselves: Earn-a-bike fixes and sells for \$5 each - usually give out 60 per summer
 - Personal injury lawyer from Boston donates a helmet for every kid who gets a bike
 - Regular programming: used to be one could volunteer anytime: now more structured: result: less chaotic in shop. Now there is Volunteering time / open shop time
 - 501c3: official non-profit.

- Have a board of directors and president: but run more as collective. Long term volunteers can opt to be work to be shop manager: Once trained get a key to the space. Work hours in the shop and are free to use space.
 - Matt runs youth night and half of the Saturdays. (others: adult night, femme night)
 - Between 5-7 committed volunteers shop managers at any time - more difficult if down to 3
- For what types of things do you advocate? (Awareness, safety, improved infrastructure, etc.)
 - Not formally: Though they try to publish events for WalkBike Worcester and others.
 - Partnered with Rails to Trails - might go and set up a tent and do repairs
 - Last year: commuters breakfast: do tabling
 - Is a capacity issue: don't have enough ppl to fulfill the mission and to also do more advocacy
 - Do try to do rides: a couple Critical Mass rides per year, other group rides around the city to get people aware of bicycles: People see others biking and may think "if they can ride bikes, so can I"
- How is your relationship with Clark University and WSU?
 - Clark: dwindled because they grew. Cycles for change: once club was set and got funding from school to set up own shop. Don't interact with Worcester Earn-a-Bike unless need full bike or something they don't have.
 - Tough because Cycles of Change struggling to maintain membership
 - WSU: Bike share was a push from administration - professor / Mark Wagner worked to get bike share on campus
 - Earn-a-bike built 5 bikes and WSU purchased bikes with locks and helmets
 - WSU built the system administratively, but got hardware from Worcester Earn-a-Bike.
 - Discussed possible system of Earn-a-bike coming in once a week, but WSU didn't have the funds.
- Are you looking to expand university involvement in the future?
 - Thinks it would be awesome - great for Earn-a-bike and great for Woo.
 - If could set up Dream would be to have between all the colleges a bike share that could be used to go from school to school.
 - Potential need for going to consortium classes
 - Because students are always rotating through: org that stays with the city and programs would be helpful to maintain continuity of leadership.
 - Worcester Earn-a-Bike looking into funding opportunities hiring part-time employee.
 - Director ~2003-2013: program on his shoulders - did EVERYTHING.
 - Never looked into funding, when he left was tough because everyone else couldn't really fill the big shoes. Currently looking for funding opportunities. - Someone working for earn-a-bike could help organize between the colleges:

- Would need to start to make sure bike share would be viable.
 - WPI great for bike share. Closer to downtown than Clark: student population less afraid of getting on bike / going around Woo. Woo state 70% commuter.
- Could WPI go with the “Clark Method” of volunteering at Worcester Earn-a-Bike to obtain the bikes for a bike share?
 - WPI: Clark method: nothing has to be different: anyone already can come and volunteer. Matt: organized wheels for 3 hours. Students could come down and work on a day not usually open and get bulk set of hours and “donate” them toward the bike share.
- Clark had no funding. However, you learn how to fix as you learn. The used bikes will break more easily. If could get some funding, all of the essentials could be replaced if needed. Could put on new / better parts on bikes there so are a bit more rugged. For WSU: Earn-a-bike did this. New cables, housing, re-greased. If parts were not going to last, then swapped out for better part.
- Could try to approach bike manufacturer. Could throw some bikes for cheap. Then Earn-a-bike could build up bikes.
- One reason Cycles for Change has been successful: did get students down to work on bikes: Realized it is fun and interesting, “I’m going to stay committed”. Results in personal ownership with the bikes.

Final comments

- Hear from earn a bike, lots of people apprehensive about riding, where to go. For students with bike share: to be successful, have info campaign: fun activities, group rides, Clark: good run for a while with rides on Fridays for 1.5 hours going to a certain location / riding around the city.
- Groups of younger adults: “loops ride” other smaller groups are in Worcester focused on social dynamics.
- Get opportunities out so people know of them.
- WalkBike, 7 Hills Wheelmen, have resources of places to go. Example: Gas light tour: natural gas tour 26 in Woo. Mother’s Day ride: historic locations in Woo related to suffrage / women’s rights. If advertise to college student, could do well.
- Stick to side streets / slower roads. Even if high traffic but slower still fine. Cars go pretty slow on Main St even though there are many lanes / is a wide road for example.

B.3 Questions for WPI Stakeholders

Interview with Dean Joseph Sarkis and William O’Brien, of the Robert A. Foisie School of Business
2/20/2015

- What do you think the benefits to students would be from this program?
 - Exercise and health
 - Speed and easy access
 - Reduction of need for parking
 - Flexibility

- Can become more a part of the community through travel out into city
 - Enhances WPI's brand to prospective students (O'Brien)
- What are some potential obstacles to the implementation of a program such as this?
 - Finances
 - Ongoing management - issues with continuity of leadership
 - Geography and hills
 - Infrastructure (or lack thereof in terms of bike lanes)
 - Changing habits and behavior
- What aspects of WPI are advantageous to such a program?
 - College students
 - young and healthy
 - like to exercise
 - Freshmen cannot have cars
 - Increasing summer course offerings: More people to use bike share when weather is at its best
 - International students who don't have drivers' licenses
 - Growing concern for sustainability in the classroom and on campus
 - Growing core of faculty interested in and researching sustainability
- How do you think such a program should be organized? Who should run it?
 - Someone-Faculty or staff should serve in a role long-term to maintain continuity of leadership
 - More likely staff member than faculty-maybe both
 - There should be a joint effort between students, faculty, and staff
 - Maybe a representative from the Healthy Herd
 - Student Government Association (SGA) (Sarkis served on advisory board)
 - SGA has money and wants to spend it on projects that make an impact in the long term. One-time events improve student life and is nice and all, but they want to spend it on something for the long term
 - Sarkis: "This is that project."
- What is your opinion on student organizations running such a program?
 - Not sure about running, but definitely involved
- How could this program be integrated into the School of Business curriculum?
 - Could be used as case studies on sustainability
 - Recently, ABET accreditor for Industrial Engineering came in, said WPI has very little on sustainability
 - Could be involved in business MQPs and IQPs for expanding the program, developing bike tracking app
 - Business students interested in making money: app could make money if developed and sold to cities
- Is there a demand for entrepreneurial opportunities at WPI / do you think students would be interested in running such a program?
 - Mark Rice, previous dean could talk more about entrepreneurial things
 - Could be a future plan to expand the program so that it connects all the schools in the city

- With whom should we speak for more information?
 - Karla Mendoza-Abarca
 - Social Entrepreneurship Professor
 - Mike Elmes - Not currently around
 - Social Innovation professor

Other thoughts?

“The U.S. Government should give everyone a free bike”

Interview with the WPI Dean of Students

02/12/2015

- What do you think the benefits to students would be from this program?
 1. Efficiency
 2. Health
 3. Convenience: Needs to be convenient: need the hubs to be around the highest concentration of students
 - a. Lower Campus: East Hall, Founders Hall, Fraternities
 - b. Quad
 4. City travel: Able to grab a bike and ride to price chopper, experience more of the city, especially for those who otherwise may not due to lack of a car
- What aspects of WPI are advantageous to such a program?
 - The “Time Economy”
 - The value everyone places in their time
 - Term system: 7 week courses
 - Distorted perception of distance
 - People want take the most efficient way to where they are going
 - Reason why people drive - think will be faster
 - We should prove - obtain data to show this is not the case
- What aspects of WPI are disadvantageous to such a program?
 - Security, physical geography
 - Barriers
 - Safety and helmet
 - Locking mechanism
 - Some liability for bike while in your protection: need to lock
 - Increased bike use increases pedestrian risk
- Do you think students should / would be willing to pay for a bike sharing program?
 - Students should be willing
 - Incentive: Personal commitment / responsibility to bring bike back if students have paid for it
 - Have to hit the sweet spot: Talk to students
 - If late to class, interested in sustainability, want to explore the city, exercise
 - Marketing: Whatever the cost is, make it relatable such as “the cost of 1 cup of coffee per month”
- How willing do you think the University would be willing to pay for the program?

- Jointly funded between SGA and the university
- How late in the day do you think students should be allowed to rent bicycles?
 - Two options depending on how program is set up
 - 1) Internal focus: Mostly trips between campuses: 12 hour
 - 2) External focus: Make trips off campus, ex: to Clark: 24 hours
- What is your opinion on student organizations running such a program?
 - How do you think we should go about contacting potential orgs? Have some in mind, may be others we do not know. Student activities?
 - Contact organizations to attend GBM or Exec meeting
- With whom should we speak for more information?
 - Christine Kobza, Assistant Director of Student Activities
 - Oversees community service including community service van
 - Students could bike to community service if close by
 - We could possibly identify community service: take part in bike program
 - Could be paid to run program / do maintenance
 - Sports and Recreation Center
 - Alan Carlsen: Grounds
 - Ask: "What would it take to install these stations?"
 - Types

Interview with the WPI Vice President of Human Resources

02/12/2015

- High percentage of faculty and staff living 7 miles from campus
 - Within the bikeable distance
- What do you think any benefits to WPI would be from this program?
 - Parking is an issue
 - Could reduce the number of vehicles
 - Health of employees - encourage to be healthier and exercise.
 - Healthy Herd: Health and Wellness program
 - Health insurance for employees: ~\$19 million
 - Lunch hour: faculty and staff walk, go to rec center, and wait for a stationary bike.
 - Bike share could be used instead / in addition
- What do you think any benefits to WPI faculty and staff would be from this program?
 - Above
- What health incentives are there for faculty and staff? Healthy Herd? Would this align with goals?
 - Yes
- How do you think this program would change the way prospective employees view WPI?
 - Displays sustainability, care about health of employee definitely encourages coming to WPI
- What are some potential obstacles to the implementation of a program such as this?

- Resources
 - Though Bike share not a huge expense
 - Charging a fee would help
 - University would likely be willing to fund
 - Sustainability position will be filled in the future, difficult to find people
- What aspects of WPI are disadvantageous to such a program?
 - Bike thefts in the area, program must be secure
 - Safety for riders - general concern
- How willing do you think the University would be willing to pay for the program?
 - Shared by university and participants
 - Who should we talk to?
 - Proven process for implementation of student ideas: SGA to Student Affairs to administration (Tobacco-free campus)
- Any final thoughts or suggestions for our future work?
 - Students should be the motivators in this area, not employees (Because it has greatest chance of success if comes from students)
 - Safety concerns
 - Many employees exercise during the day, could help
- With whom should we speak for more information?
 - John Sullivan - secretary of faculty
 - Mark Richman - incoming secretary of faculty
 - Faculty governance: committees for running academic portion of institution
 - Secretary is “head of faculty”: speak for faculty, run faculty meetings
 - Liaison between faculty and administration
 - Connie Aramento - advising, chair of Healthy Herd
 -

Interview with WPI Green Team Officers

02/22/2015

We met with incoming and outgoing exec board at their transition meeting. The president later discussed the bike project at a general body meeting.

- Was the Green Team involved in Sustainability Report?
 - No
- Does this project align with the goals of your organization?
 - Yes;
 - Green Team goals:
 - Sustainability on campus
 - Cross-disciplinary, not involved in just one discipline
- What do you think the benefits to students would be from this program?
 - Physical, healthy
 - Saving gas money
 - Using a bike without owning one
 - Don't have to store in room
 - No risk of storing own bike outside

- What are some potential obstacles to the implementation of a program such as this?
 - Snow
 - Theft
 - Hills
 - Road conditions
 - Maintenance
 - Allotted time usage
 - Student acceptance, safety
- What aspects of WPI are advantageous to such a program?
 - Two separate locations on campus
 - Health awareness atmosphere
- What aspects of WPI are disadvantageous to such a program?
 - Snow
 - Hills
- Do you think students should / would be willing to pay for a bike sharing program?
 - Depends how much
 - Flat fee: \$50 - Thought a daily user, such as one going from Gateway to main campus would be willing to pay this
 - Different fees depending on use
 - Short usage: \$20 - Freshmen, who are likely to use less frequently
 - Monthly pass: \$5
 - One time use: \$1
- What is your opinion on student organizations running such a program?
 - Good idea, good PR for the organization
 - Better to have one organization, not many
 - Though could have service-oriented group, and maintenance-oriented group
- Would your organization be interested in assisting in the running of such a program?
 - Yes
 - Something new, Green Team has annual events such as Recyclemania, car show, lighting fair, etc. but this would be permanent
 - Aligns with goals of Green Team
 - Have something that belongs to Green Team
 - Full circle from bike blender
 - Earn-a-bike!
- Who else should we talk to?
 - Talk to Sustainability Task Force
 - Writes the Sustainability report, has money to fund sustainability projects

Notes from Green Team General Body Meeting

- Green Team Role: want to have a single club (us!) to run the program due to our ties to campus sustainability, take on their project process
- Goal: Improve sustainable campus transportation options, health benefits as well
- Thinking of two storage centers located on campus and at Gateway/Faraday
- Team discussion:

- Security issues-would utilize key and lock system, potentially check out with ID, make bikes very WPI-esque (paint, decals, etc.), work with Campus Police
- GPS to keep track of bike?
- Obtain bikes through Earn-A-Bike (work on bike for 10 hours and earn a free bike, will also assist in maintenance)
- Winter weather: WSU and Clark close during winter, open after spring break
- Use their programs as base concept

Interview with Professor John Orr, Co-Chair of the WPI Sustainability Task Force

2/23/2015

- What do you think the benefits to WPI would be from this program, particularly as it relates to sustainability?
 - Aspects to WPI as an institution: less need for parking
 - Discouraging Cars and parking
- What do you think the benefits to students, faculty, and staff would be from this program?
 - Students / riders fac. staff:
 - Exercise, saving money
 - Only detriment is bad weather, not having car: difficult to travel
- What are some potential obstacles to the implementation of a program such as this?
 - Fundamental obstacle: Encouraging more bike use
 - City: How argue for putting more bike lanes, if not there is not a lot of use
 - Bike share: need enough use to keep it going
 - If charge to use program: Need to make enough money
 - If not, need enough use to continue funding
 - More bike use needed to get bike share program
 - Bike parking facilities, physical space
 - Zipcars work well on campus
 - making it convenient enough in locations
 - initial start-up cost
- What aspects of WPI are advantageous to such a program?
 - Pretty good sustainability awareness: people potentially interested
 - WPI administration should be supportive
 - Fits in well with sustainability plan
 - Come up with ideas for places to go - when marketing the program
- What aspects of WPI are disadvantageous to such a program?
 - Weather, relatively small, don't need between classes (exception of Gateway and Faraday)
 - A little hilly - campus so small, though not really a disadvantage
 - WPI well situated to give access to surrounding areas
 - Not too narrow streets (Salisbury ok, not necessarily highland).
- How driven is the university to accomplish the goals of the plan?

- Is committed: Important aspect = new president and provost. Have met with President Leshin: has shown personal commitment and of WPI toward sustainability.
- Position of sustainability coordination: on hold until new provost: depending on his commitment of sustainability. Provost starts June 1st. Will discuss sustainability: It is what the top admins say and do that show commitment to sustainability.
- Confident that commitment is there
- Students and faculty, not just administration, have to want it as well
- IQP: Most IQP's relate to sustainability, even if not explicitly stated
 - Integral to academic program
- Minimizing driving: bicycling is good approach.
- Do you think students should / would be willing to pay for a bike sharing program?
 - From the point of view of sustainability, WPI should charge everyone for parking, both to recover some of the costs and to discourage automobile use. Some schools charge as much as \$1000 per year.
 - However, may be best to make it free to encourage getting started. Could not answer with confidence: what works with respect to the plan. Not unreasonable, but if the goal is to institute a new culture, should make it free. Could say first year is free, then next year is a fee. Alternative: fee for all students built in.
- How willing do you think the University would be to pay for the program?
 - From the business side of WPI, that office is very supportive of the goals of the university.
 - However, it is also true never enough money for all things like to do. Matter of amount needed and payback:
 - Payback not necessarily needed in money: quality of life (show this payback in report). Admin would want to see high probability of things working out. Certainly open to these sort of expenses.
- What is your opinion on student organizations running such a program?
 - Yes! In favor of them doing as much as possible. Examples of schools students taking the initiative. A possibility: certainly able to. Lots of good ideas: need to be implemented well. Need to pay people if the administration runs it.
- Who should we speak with for more information?
 - Grad students: a lot without cars
 - Many are from countries with biking cultures.

Interview with the WPI Office of Admissions Staff Members

02/27/2015

- What do you think the benefits to students would be from this program?
 - Gateway drug! Encourages healthy habits, entry point to better lifestyle
- What are some potential obstacles to the implementation of a program such as this?
 - Students don't need to bring their own bike to campus, reduce space on campus
 - Theft
 - Maintenance issues

- University liability
- What aspects of WPI are advantageous to such a program?
 - This generation of students is concerned with sustainable practices
- What aspects of WPI are disadvantageous to such a program?
 - Winter
 - Hills
 - Worcester roads not ideal for biking
 - Narrow streets, though there are alternative routes
 - Recommend routes
 - Widen path through Institute park
 - Kris Billiar, always biking - proof it can be done
- Do you think a bicycle sharing program would attract potential students to WPI? If so, how and why?
 - Regularly ask about cars on campus, tour guides point out Zipcar, this could be alternative
- Does WPI make an effort to be a sustainable campus?
 - Getting there, not as sustainable as others
 - Effort to increase carpooling
 - Generational concern
- How does the Admissions office project sustainability on campus?
 - [no answer]
- How interested have you found potential students to be in sustainability practices? In biking?
 - [no answer]
- Do you ever see applicants with interests in bicycle repair or general hands on mechanical skills / hobbies?
 - Yes
 - International students bike a lot, due to cultural differences
 - Major Taylor Blvd, named after a famous cyclist
- How willing do you think the University would be to pay for the program?
 - [no answer]
- What is your opinion on student organizations running such a program?
 - [no answer]
- With whom should we speak for more information?
 - [no answer]

Interview with Alfredo DiMauro, Assistant Vice President for Facilities, President's Task Force on Sustainability

3/5/2015

Discussion of Campus Plan, Maps

- Board of trustees asked to potential identify sites for building
 - Ex: Library parking lot
 - Residential, academic & research, parking sites

- Academic: From Gordon: 5 minute walking radius
 - Right to the entrance of Faraday
- Housing: From CC: 5 minute walking radius, and 7.5 minutes
 - Salisbury estates, Faraday in 7.5 minute zones
- Campus life:
 - Sites are located within selected radii of different central locations eg: Goat's Head, Morgan, CC
 - Faraday is isolated
- Pathway Connections:
 - Developing bike-friendly pathways (Through developing handicap accessibility)
 - Pathway through connector between Alumni and Harrington
 - CC to HH
 - Straight path from Dean St to West street by library, Boynton hall
 - It is a "straight line" but because of the steepness of Boynton hill, there can't be a straight bicycle or handicap path between Dean St and West St (and the Quad.) there is a plan however to play with the area around beech tree circle which will eliminate the stairs at the west end of Earle bridge, allowing you to ride your bike across the bridge, from Boynton Hall to Alden Memorial and on to the Quad.
 - Completed path during Institute Park
- Path from Faraday Hall entrance to Faraday St by SAE: ramp proposed, would be bike friendly because of accessibility
- Parking: Gateway, Park Avenue, Dean Street 5 min walking radius
 - Park Avenue: main campus
 - Gateway: Gateway and Faraday
 - Dean St: fills in gap
- Parking garage removed need to park inside campus, got more walking and biking space on campus.
- We want to know what kind of system is best for WPI and would like your input.
 - Manuel system with checkout not as streamlined or professional/polished as keypad or swipe
 - Automation is key
 - Bike shop for space to maintain/store/rent
- Clark U: Bike shop in former janitorial closet in basement of residence hall. Are there any free spaces on campus or such spaces that could be converted?
 - Could envision gated in space in one of the garages - Currently bike shelter in East Hall.
 - Bike share does not require windows
- Do you feel a bike share would help connect the two campuses?
 - Definitely
 - Their projects are focused on connecting the campus
 - Always adding bike racks when able to
- How do you feel Institute Park could come into play? What would a bike share do for the park, vice versa?

- Seasonal use/draw
 - Booth/station for community interaction
- What factors are there for installing bike racks? Awning? Are there any locations that would work best / worst?
 - Area, pouring concrete
- What do you think the benefits to WPI would be from this program, particularly as it relates to sustainability?
 - Manual power, good solution to transportation issues
- What do you think the benefits to students, faculty, and staff would be from this program?
 - Sustainability; not have cars back and forth from Gateway, around campus, emphasize walking or biking
 - Biking provides a mix of speed, sustainability
 - Create more green culture on campus
 - Faculty and commuting
- What are some potential obstacles to the implementation of a program such as this?
 - Physical barriers, infrastructure issues
 - Courtyard Marriott as a hub for bike sign-out by Gateway
 - 24 hour sign out at front desk
 - Winter/seasons
 - Rec Center: covered parking for bikes, parking garage, etc.
 - Insurance
 - Safety
 - Develop a path to circumnavigate the Pond
- Clark U: Bike shop in former janitorial closet in basement of residence hall. Are there any free spaces on campus or such spaces that could be converted?
 - Could envision gated in space in one of the garages - Currently bike shelter in East hall garage. The bike room is actually in East Hall, accessible from the sidewalk between East Hall and Founders Hall.
- What factors are there for installing bike racks? Awning? There is an awning that matches the bike racks. I saw it down at the bus station by Union Station; looks pretty cool.

Follow-Up Information:

From Proposed Pedestrian Path Connections

- WPI is placing an emphasis on accessibility for all users. This also helps create pathways suitable for biking.
- A new pedestrian connection to Salisbury Estates could facilitate easier biking from the main campus to Salisbury Estates as well.
- Connection from the Park Ave Garage would allow bikes to be stored at the garage and ridden directly onto campus (as opposed to riding out onto Salisbury St and in the West St entrance from Salisbury St).

Housing Growth Sites and Building Development Sites (On the Pathway Connections map)

- As buildings are developed further from the center of campus, the applicability to riding a bike onto campus increases.

Parking

- Between 2004 and 2013, 240 parking spaces have been removed from quad, West Street entrance, Skull Tomb and library service roads, Goddard Hall, West St entrance from Salisbury St, and the circle at Atwater Kent. In addition parking was removed from one side on Boynton St providing increased safety to pedestrian, motorists, and bicyclists.
- Removal of parking from the center of the main campus opens up the campus for safer pedestrian and bike travel.
- In the long term, more parking can be removed, such as the spots at Goddard, the library lot and garages can be built to accommodate additional parking.
- Gateway Garage (current or expanded) – “available spaces will do little to help shortage at the main campus. My thought was that if a bike share was set up at the garage, people could elect to park there and grab a bike to ride onto the main campus, similar to taking a shuttle.
- “Demand management policies should be explored that could help control the need for parking by placing more restrictions on parking users, and by encouraging alternative means of transit, such as implementing ride-share programs, improving busing and biking opportunities.”

Other findings

- There is the possible for additional bike stations around campus if the bike share proves successful.
- Based on the maps / data, these locations are Salisbury Estates, between East and Founders (with fraternities and sororities in the area as well as a building development site), the Park Ave Garage, and the Gateway Garage.

Additional questions:

- One potential site for a bike share station is to the left of the campus center doors facing the south (the ones you would walk into if walking through the wind tunnel to the CC). Is there any risk of that area being closed off if / when renovations / construction occur on and around Alumni Gym?
 - Yes, some amount of that space will go away during the construction work at Alumni Gym.
- We are calculating costs for arranging various bike share systems. Do you know the cost of a bike rack that WPI has purchased in the past? I found the Ultra Play Systems 5000SM Horizons Bike Rack – Surface Mount for \$257.
 - This rack looks similar to those you have been installing. We have been using Orion bike racks. The cost similar, but there are shipping costs on top of that. I would use \$300 in your calculations. <http://www.belson.com/Orion-Round-Tube-Bike-Racks>
- For a potential connection between the Park Ave Garage and the library, there is somewhat of an upward slope. Has there been a study on that slope, or the % grade? Is there a certain % grade needed to meet accessibility standards?

- There is a pedestrian bridge planned to link the rooftop fields to the promenade behind Harrington. That will allow you to ride your bike (wheelchair, or walk) from the library straight onto the rooftop fields. The elevator or stairs will take you down to the garage. When the bridge is added, we may want to add some bike racks at the rooftop fields.
- In addition to the information pulled from the maps and text, will we be allowed to use any of the actual images of the report that will be published online through the Library website?
 - Yes.

Interview with WPI Fitness Club Officers

03/05/2015

- What do you think the benefits to students would be from this program?
 - Increased fitness
 - No need to bring a bike to campus
- What are some potential obstacles to the implementation of a program such as this?
 - Rules and regulations prohibiting clubs from using the program en masse. i.e., restriction on how many bikes can be taken out at one time.
- What aspects of WPI are advantageous to such a program?
 - Students as a whole are interested in fitness
 - Students interested in spinning class option
- What aspects of WPI are disadvantageous to such a program?
 - Hills
- Does this project align with the goals of your organization?
 - Programming and events coordination
 - Coordinating rides
 - Idea: NSO event promoting bike share and fitness club
 - “Tour of campus”
 - Group rides
- Would your organization be interested in assisting in the running of such a program?
 - Interested mostly in two way marketing
 - Co-sponsoring programs

Interview with the WPI Student Government Association Committee on Student Life Issues

3/16/2015

- What do you think the benefits to students would be from this program?
 - Travel for classes at other places (HS, colleges)
 - Consider options such as living at Faraday, research in Gateway
 - Inexpensive travel even if it is a small fee
 - Travel to Union Station
 - Visiting downtown Worcester and other places in the city
 - More attractive for marketing WPI to prospective students, faculty
 - Students doing IQP at project center, Worcester IQP

- What are some potential obstacles to the implementation of a program such as this?
 - Bike paths and safety
 - Weather and snowy streets
 - Education and the process of borrowing the bike
 - Some programs are not taken advantage of because nobody knows about them
 - Safety and wearing helmets
 - Storage, headquarters for the share
 - Bike maintenance and repair
 - Where can students keep a personal bike
- Does this project align with the goals of your organization?
 - Yes; focused on student life
 - In addition, students living off campus can get back and forth easily
- In what ways do you see a bike share program as being similar to SGA's other projects and activities?
 - Nothing really similar
- What interest in bike sharing does SGA have or had in the past?
 - Has there been any work done on it recently?
 - Yes; at the SGA town hall
 - Also bike storage and safety
- Is SGA interested in funding long-term projects, as opposed to one-time events?
 - Yes, provided the project is well planned and presented
- If so, what resources are used / available for long-term impact projects?
 - Sponsorship account for long-term projects
 - Could use funds set aside for a legacy project as well
- Would there be any issue with the bike share being open to undergrads, grad students, faculty and staff?
 - Approach GSG as well; Dean Clay is the contact there. (Correction: It looks like Associate Dean of Students, Gregory Snoddy is the advisor-Kevin)
 - Would be willing to help, but not as the full sponsor. Approach other organizations as well
 - Committee on Fiscal Responsibility and Assistance
 - Works with groups requiring help with funding
- If SGA is interested in pursuing a bike share after our project is done, how would the idea be moved along?
 - Meeting with CFRA (above)
 - Develop costs and details on funding
 - Submit to financial board for approval
 - Money can then be spent

Interview with an Assistant Director of WPI Residential Services

03/22/2015

- What do you think the benefits to students would be from this program?

- Depends: takes some time with education
- What are some potential obstacles to the implementation of a program such as this?
 - Membership fee and waiting periods
 - Sign up before getting to school
 - Uber open in July - Slowly expanding to campuses
- What aspects of WPI are advantageous to such a program?
 - Reduction of cars always good
 - If students use bike share instead of bringing own bikes
 - Less likely bring bikes into buildings, tracking stuff into buildings
 - Revenue if set up for that
 - Sustainability, going green
- What aspects of WPI are disadvantageous to such a program?
 - Storage space. - only current one = East hall
 - Traffic flow - room for the traffic walking
- How do you think a bicycle share program would affect student life at WPI?
- Would a bike share align with the goals of Residential Services?
 - Benefit to two way traffic between Faraday and campus in terms of selling the space
 - Where stored, who managing - Depends where fall in program - res services currently contracts with outside vendors
 - Most programming funds for things in halls come from outside vendors
 - New partnership - more funds for programs
- One of our recommended sites for a bike share station is at Faraday / Gateway Park.
 - Hear comments about how far away Faraday Hall is from the main campus: could a bike share change that perception?
 - could help - as a selling point
 - Largest group: 258 at Faraday currently
 - Do you ever have any issues with bikes in the residence halls? Issues with bike storage?
 - Bikes in res halls - take up more space, leads to less student space
 - Doesn't help with roommate situations
 - Not always positive when happens
 - Any other potential sites to consider?
 - Quad, CC, between East and Founders (fraternities, sororities too plus 500 people in East and Founders)
 - Gateway / Faraday - different because city streets
- How willing do you think the University would be to pay for the program?
 - Not res services, don't have start-up funds
- With whom should we speak for more information?
 - Christine Girard - Student Activities

Interview with the WPI Student Government Association Treasurer and Committee on Fiscal Responsibility and Assistance (CFRA)

3/27/2015

General

- What do you think the benefits to students would be from this program?
 - Travel between main campus, Gateway
 - Not really around campus
 - Parking garage
 - Benefit to freshmen - getting to Price Chopper and Worcester, Main St., Park Ave.
- What are some potential obstacles to the implementation of a program such as this?
 - Cost - initial cost and upkeep
 - Who would do upkeep
 - Who has liability
 - Finding locations on campus for stations - not much space
 - Snowy city: finding a place to store bikes
 - Rain concerns: store in garage
- What aspects of WPI are advantageous to such a program?
 - Everybody is constantly moving and on a schedule
 - Convenience, esp. time convenience
 - Separate campus creates need
- What aspects of WPI are disadvantageous to such a program?
 - Unique school - not good with culture change
 - Grow program over time
 - Won't be used on campus, just getting around is better

SGA / Funding

- Does this project align with the goals of SGA?
 - It does: improves life on campus, people getting around campus
 - Reaches out to undergraduates, see use by freshmen
- In what ways do you see a bike share program recommended through our IQP as being similar to SGA's other projects and activities?
 - Water fountains: SGA funded the initial investment, but the university picked up the funding
- What interest in bike sharing does SGA have or had in the past?
 - Not formally
 - People are excited in the program when asked
- Is SGA interested in funding long-term projects, as opposed to one-time events?
 - Yes
 - They fund SNAP
 - Alden Memorial sound system
 - Create a legacy
- If so, what resources are used / available for long-term impact projects?
 - Started as case-by-case
 - Created a legacy fund, not really formal, still in development

- Helped fund the Rec Center, Campus Center
 - Don't want to continue investing in some cases, just initial push
 - EPAC (Event Planning and Advisory Committee)
 - Funding for clubs, for events, usually one time
 - Luke Habib sgaepac@wpi.edu
- Do you believe SGA would be willing to fund a bike share?
 - Definitely interested in looking into it
 - Present to SGA: Tuesday April 14th at 6:20pm
 - CFRA can help present
- Would there be any issue with funding since the bike share would likely be open to undergrads, grad students, faculty and staff?
 - Fund the proportional amount for Undergraduate population
 - Contact GSG and Dean Snoddy for faculty + staff
- If SGA is interested in pursuing a bike share after our project is done, how would the idea be moved along?
 - CSLI would help move it along once it's funded

Interview with the WPI Police Department

3/27/2015

- What are the important security considerations for a program such as this?
 - U-locks are great
 - Open campus - security of bikes
 - Criminals are dumb but street smart as well
 - Targeting large groups of bikes
 - Stealing parts of the bike (seats, nuts, bolts, wheels)
 - No area where bikes are stolen more than others, but heavily used racks are more often hit
- What concerns would the Police Department have with this kind of program?
 - Influx of creating more targets for potential theft
 - Bike safety
 - International students who may not be as accustomed to bikes and rules of the road
 - Educational component
 - Community service division - education for areas, bikes included
 - Officer now retired
 - Brought up with safety talks in dorms
 - Proposal to buy U-locks and sell at a discount
 - Find a public room for bikes (cage idea)
 - Faraday courtyard, much more safe than outside Faraday on sidewalk / street
- How late in the day do you think students should be allowed to rent bicycles?
 - Length of time cap preferred over time of day for bike return
- What is campus police's policy on abandoned bicycles?
 - Not sure

- Abandoned bikes entered as abandoned property
 - Police Department tries to return bikes to rightful owners
 - Evidence and found property division
 - PD is currently working to conform to national standards
 - Donated lost property to charitable organizations in the past (not necessarily in the future)
- What do you think the benefits to students would be from this program?
 - Faraday + Gateway travel
 - High percentage of people would use in the future
 - Many “frequent flyers”
- What are some potential obstacles to the implementation of a program such as this?
 - Proven program at other institutions
 - Not many other obstacles
- What is your opinion on student organizations running such a program?
 - No problem
 - SNAP and EMS are student-run organizations run out of the Police Department
 - Great idea
- Do you have any final comments or suggestions?
 - Look for public internal space
 - Meredith Merchant in the Rec Center
 - Could donate internal space
 - East Hall garage
 - Doubles as winter storage space
 - WPI PD can definitely secure bikes in PD control, but not necessarily bikes on campus
 - Creating rack space in a secure location

Interview with Graduate Student Government (GSG) Officers

04/02/2015

- What do you think the benefits to students (specifically graduate students) would be from this program? (Our recommendation is to have bikes on the main campus as well as near Gateway Park)
 - A lot
 - The same as for anybody
 - Go to Gateway a lot
 - A Grad social at Gateway
 - Price Chopper would be good
- Does this project align with the goals of your organization?
 - Yes
 - Improve the social life of graduates
 - Gets all students together
 - Improve academic life of students - can get to Gateway faster, not be late to class

- Is GSG interested in funding, in part with SGA (undergraduate) for example, long-term projects, as opposed to one-time events?
 - Yes, if the GSG logo is on the bike
 - Budget is limited
 - It depends on how much is asked for
 - Come up with an estimate and give it to GSG
- If GSG is interested in pursuing a bike share after our project is done, how would the idea be moved along?
 - Give them a breakdown of budget, present it to GSG
 - Extend idea to the city

BIBLIOGRAPHY AND PHOTOGRAPH SOURCES

- [Untitled photograph of helmet]. Retrieved April 26, 2015, from:
https://farm5.staticflickr.com/4094/4857071704_9892508221_o.jpg
- Academic and Research Growth Sites [Image]. (2014). Retrieved March 29, 2015, from 2014 Addendum to the Campus Master Plan.
- Bike share customer fleet bicycle [Image]. Retrieved March 31, 2015, from:
<http://www.onbikeshare.com/bike-share-system/bicycles.php>
- Bike Share Implementation Strategies: A Comparative Guide. (2013).
- Bike share rack with electronic key box [Photograph]. Retrieved March 31, 2015, from:
<http://www.onbikeshare.com/bike-share-system/bicycleracks.php>
- Blackstone River Greenway - Bike Path. (2014, November 1). Retrieved May 3, 2015, from
<http://www.blackstonevalleycorridor.org/explore/bikeway/comprehensive-overview-11-20>
- Brayj, U. (Photographer) *Batavus* [Photograph], Retrieved from:
<https://www.flickr.com/photos/ubrayj02/3860758697/in/set-72157617203014066/>
- Campus Life Growth Sites [Image]. (2014). Retrieved March 29, 2015, from 2014 Addendum to the Campus Master Plan.
- Capizzio, R., Hunter, F., Martin, D., & Miller, L. (2012). A Bikeway Network for the City of Worcester. (Undergraduate Interactive Qualifying Project No. E-project 031212-075939). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection:
<http://www.wpi.edu/Pubs/E-project/Available/E-project-031212-075939/unrestricted/IQP-WorcBike.pdf>
- Cyr, D., Hannoush, A., Josephs, M., & Mikelonis, A. (2014). Promoting Alternative Transportation for the WPI Community. (Undergraduate Interactive Qualifying Project No. E-project-031914-1451117). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: https://www.wpi.edu/Pubs/E-project/Available/E-project-031914-145117/unrestricted/Final_Report_3.pdf
- Housing Growth Sites [Image]. (2014). Retrieved March 29, 2015, from 2014 Addendum to the Campus Master Plan.
- Huggins, J. (Photographer) *Circular bicycle rack* [Photograph], Retrieved from:
<https://www.flickr.com/photos/jezhug/8150033797/>
- Laguarda, I. (2015, January 15). Hubway. Retrieved May 8, 2015, from
<http://www.thehubway.com/news/2015/01/15/Wicked-Local-Brookline-Committee-would-look-at-making-Hubway-system-self-sustaining-convenient>
- Long Term Parking Improvements [Image]. (2014). Retrieved March 29, 2015 from 2014 Addendum to the Campus Master Plan.
- Near Term Parking Improvements [Image]. (2014). Retrieved March 29, 2015, from 2014 Addendum to the Campus Master Plan.
- Proposed Pedestrian Pathway Connections [Image]. (2014). Retrieved March 29, 2015, from 2014 Addendum to the Campus Master Plan.
- Restaurants Map* [Image]. Retrieved May 3, 2015, from:
http://www.trulia.com/real_estate/Central_Business_District-Worcester/23727/

Royal, D., & Miller-Steiger, D. (2008). National Survey of Bicyclist and Pedestrian Attitudes and Behavior. Volume III: Methods Report (No. HS-810 973).

Shopping Map [Image]. Retrieved May 3, 2015, from:

http://www.trulia.com/real_estate/Central_Business_District-Worcester/23727/

The College Sustainability Report Card. (2011). *Worcester Polytechnic Institute*. Retrieved from:

<http://www.greenreportcard.org/report-card-2011/schools/worcester-polytechnic-institute.html>

WPI Residential Services. (n.d.). Faraday Hall. Retrieved December 10, 2014, from

<http://www.wpi.edu/offices/rso/faraday.html>

WPI Sustainability Plan (2013). Worcester Polytechnic Institute. Retrieved March 29, 2015 from

http://www.wpi.edu/Images/CMS/Facilities/WPI_Sustainability_Plan.pdf