Bike-Share Meets Lafayette

A tangible and visible program promoting Lafayette College's sustainability mission, student values, and wider community engagement.

Keven Lugo, Sam Kalra, Asha Hedrington

The Team

The ideas outlined in this proposal would have not been possible if not for the cross-disciplinary nature of our team. Below please find a brief outline of backgrounds and experiences.

Keven Lugo, *BA Engineering Studies & BA International Affairs*

Double Majoring in Engineering Studies (EGRS) and International Affairs (IA) taught me more than to just choose areas of studies with ridiculously long names. By enrolling in this interdisciplinary combination of studies, and seeking leadership roles, I learned to analyze problems and develop solutions through a structural lens. For example, as a result of my IA background, I analyze all entities as states. More specifically, I think critically about the stakeholders and institutions—official and unofficial rules, procedures, organizations used to make decisions and achieve goals—that are critical for a successful outcome. In the case of the Bike-Share, this led me to conclude that a turn-key bike-share solution will work best with Lafayette's institutions. Lastly, as a big-picture thinker, I played a large role in developing the structure and vision of this project.

Sam Kalra, *BA Engineering Studies & BA Economics*

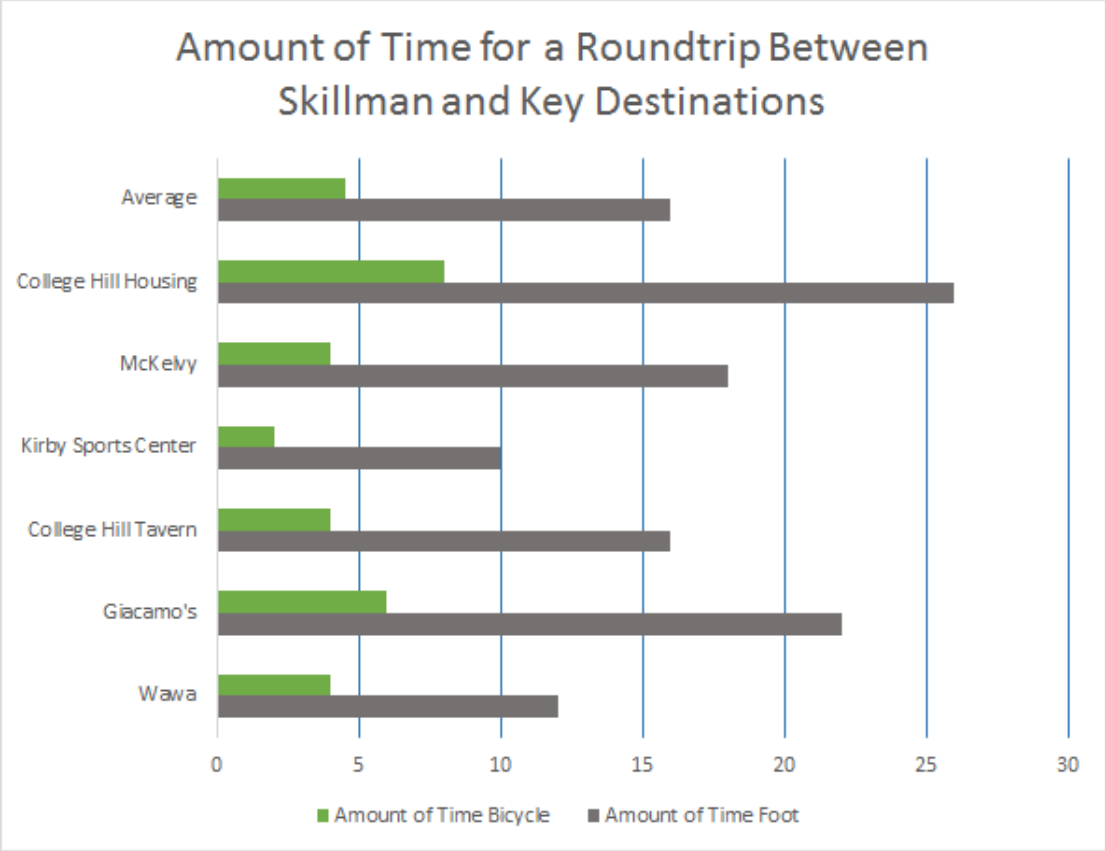
As an Engineering Studies and Economics major, I have studied both the technical and managerial sides of engineering, and the both the theoretical and financial sides of economics. Viewing a problem through these different scopes yields a high-level understanding for how to find solutions that are technically effective yet financially feasible. In the case of this bike-share system, I was able to help narrow the scope of our project to a well-defined and identifiable goal to reliably estimate costs of design, implementation, material, labor, maintenance, etc. Based on my experience I was able to play a major role in the evaluations of each alternative - including topics ranging from evaluative criteria to cost and reliability estimates of each alternative.

Asha Hedrington, *BA Engineering Studies, Minor in Architectural Studies*

Engineering Studies has taught enlightened me more than I anticipated in my freshman year. I have learned what it takes to be on both ends of the spectrum of engineering from the non technical to technical aspects. You could say that I have in a sense the best of both worlds. This mass of important knowledge has helped me secure employment with Clark Construction as an Office Engineer, where I can take what I've learned from the major and apply it to the real world.
In recent years, Lafayette College set a goal to create sustainable transportation methods. The removal of several on-campus roads paired with the reduction in parking and expansion of vehicle regulations have shown that the college is committed to providing a safe and sustainable environment for students and faculty to travel. In other words, Lafayette wants to decrease the number of vehicles on campus. Despite this, many individuals use their cars to travel around College Hill.

Bike-Share Meets Lafayette

A bike-share system would support Lafayette's initiative of sustainable transportation. Such a system allows a user to check out a bicycle from a central location on campus, ride to their desired location, and then return it later. This bike-share program would ideally eliminate the desire to drive around College Hill and encourage users to explore College Hill. This would result in a safer and healthier community environment. The most common reason for driving around College Hill is that walking takes a long time; as seen on figure 1, many popular destinations on College Hill require an average round trip of 16 minutes while walking, but the same trip requires only 4 minutes biking.



Data Obtained from Google Maps

Figure 1

In this report, we will be defining the scope, challenges and mitigating factors, and proposing three solutions for a bike-share program on Lafayette's campus. We focused on two different approaches to developing the program: outsourcing and doing it yourself. Each solution encompasses a technical and economic analysis. By evaluating each solution with defined criteria we will demonstrate which solution will be the most feasible based on scores for ease of use, cost, reliability, and ease of implementation.

Defining the Scope

Culture Overview

The culture of the city of Easton is a great barrier to the bike-share program. As mentioned earlier, the preferred method of transportation for the community members of Lafayette College, College Hill, and Downtown Easton, is driving as opposed to walking, biking, or other environmentally and physically healthy options. Furthermore, Lafayette community members have their own hometown cultures. For example, students from suburban areas have been accustomed to driving, as areas of interest are usually relatively far apart, and many suburban communities do not have public transportation systems. By comparison, students from major cities have been accustomed to walking or biking as the main method of transportation. In other words, Lafayette students who have grown up with driving as the main method of transportation may see driving around campus as a necessity, and will choose to drive rather than walk or bike.

One concept worth noting, is that biking is a popular activity, and is both healthy and convenient. Lafayette has added several new bike racks on campus, and the City of Easton has added artistic bicycle racks around downtown as well. This exemplifies that both Lafayette and Easton are working to increase the amount of cycling in their respective communities. With this information, we continue to pose the idea of a bike-share program to help push the idea of increased cycling in the Lafayette/Easton community.

Methodology

With a student population of roughly 2,500 people and 340 acres, cars are not a necessity on campus. To embed this ideology into the minds of incoming students, first-year students are generally not allowed to park on campus. Instead, with the hopes of discouraging the use of vehicles, most first-year students park in Forks Township and must take a shuttle back to campus.

Upperclassmen are permitted to park on campus, albeit registration costs a steep $400. Along with the registration costs, there are also restrictions to where students can park their cars during the day; in general, until 5 pm students must only park in their assigned lot, meaning that by driving to class or the other side of campus risks getting a ticket from Public Safety.

The main issue from a policy standpoint is that Lafayette is taking actions to discourage driving through the use of costly registration, parking tickets, and off-site parking lots, but is not providing an alternative method of transportation to its students. Regardless of the number of discouraging consequences that Lafayette may implement, individuals will continue to drive unless there is an alternative method of transportation available.

By following a series of analytical steps, a well-defined policy analysis can be formed that will help form a rational decision. This process includes defining the problem and indicating goals and objectives, considering a range of alternative solutions, developing evaluating criteria for each of the alternatives, assessing them, and finally drawing a conclusion. These steps in the policy analysis process are the templates for creating a successful solution. The formal version of this policy-driven approach can be seen in the chart below.

TABLE 4-1 Steps in the Policy Analysis Process

STEPS	TYPE OF QUESTIONS	ILLUSTRATIONS
Define and analyze the problem	What is the problem faced? Where does it exist? Who or what is affected? How did it develop? What are the major causes? How might the causes be affected by policy action?	How is cell phone use related to automobile accidents? What is the potential to reduce accident rates through policy action? How does cell phone use compare to other distractions while driving, such as use of navigation systems, drinking coffee, or talking to passengers?
Construct policy alternatives[a]	What policy options might be considered for dealing with the problem?	To reduce drivers' cell phone use, should state governments institute sanctions such as fines? Should states try to educate drivers on cell phone use? Should cell phones be disabled in a moving car if effective technology to do so becomes available?
Develop evaluative criteria	What criteria are most suitable for the problem and the alternatives? What are the costs of action? What will the costs be if no action is taken? What is the likely effectiveness, social and political feasibility, or equity of alternatives?	What criteria are most important for regulation of cell phones? Will people find these options acceptable? Is it ethical to restrict individual behavior to achieve a social goal? What options might be most effective in discouraging drivers from using cell phones?
Assess the alternatives	Which alternatives are better than others? What kind of analysis might help to distinguish better and worse policy alternatives? Is the evidence available? If not, how can it be produced?	Which policy options are most likely to reduce drivers' use of cell phones: public education or economic sanctions such as fines? How successful are the efforts of states and localities to regulate cell phone use? What kinds of evidence are needed to answer these questions?
Draw conclusions	Which policy option is the most desirable given the circumstances and the evaluative criteria? What other factors should be considered?	Should state governments impose stiff fines on use of cell phones or texting while driving? Would steep fines be accepted as a legitimate governmental action? If they work, how might such actions be made more acceptable?

Figure 2

Stakeholders

The next step in our policy analysis is to determine and define who the stakeholders would be if a bike-share program were implemented. Examples of stakeholders include faculty, students, public safety, and the residents of Easton. If a bike-share system is implemented to be used at Lafayette as well as downtown Easton, several rules and regulations between the separate communities would have to be considered. Many of these rules are created by the Zoning Department, which would require many permits for implementation. Clearly, all of these regulations and requirements exemplify that working with the city of Easton to implement a joint-community bike-share system show would be extremely difficult, costly, and lengthy. Thus, the scope of the system has narrowed the scope of this bike-share program to solely Lafayette. Should Lafayette's program succeed, it can be expanded into the greater Easton area.

The Lafayette Facilities and Planning Construction Department would be one of the main stakeholders of this system. The main contact for this group will be the director, Mary Wilford Hunt. Upon meeting with Ms. Hunt, it was brought to light that the College previously tried to implement a bike-share system, along with bike lanes. However, the proposal was not successful due to a few requirements that were unpopular with Easton residents. These requirements included

"approximately 43 on street parking spaces along McCartney Street west" and replacing with a, "seven-inch designated bike lane". While bikes can share lanes with cars on a level surface, they require their own lanes when going uphill.

Following implementation of a bike-share system, Lafayette community members will have the ability to rent a bike either for leisure or transportation. Local drivers will also be affected, as more cyclists will be on the road, which could increase congestion on already narrow roads such as Cattell and McCartney. This may create safety hazards, but these will hopefully be alleviated by drivers driving more slowly, as more pedestrians will be on the road. As Lafayette's safety organization, Public Safety will be affected, as the organization must ensure cyclists' safety and prevent theft and damage.

While the current scope of this bike-share system is solely Lafayette's campus, it is hoped that in the future the system will be successful enough to expand the following areas throughout the greater Easton area.

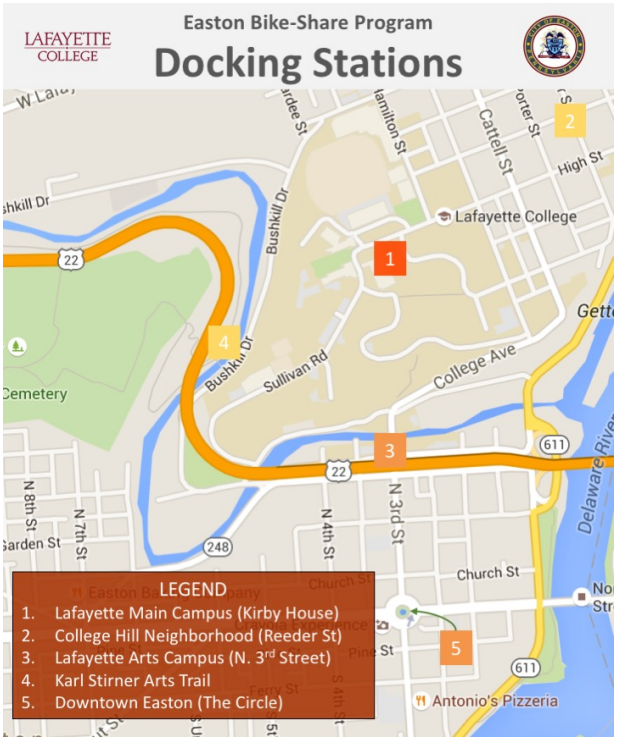


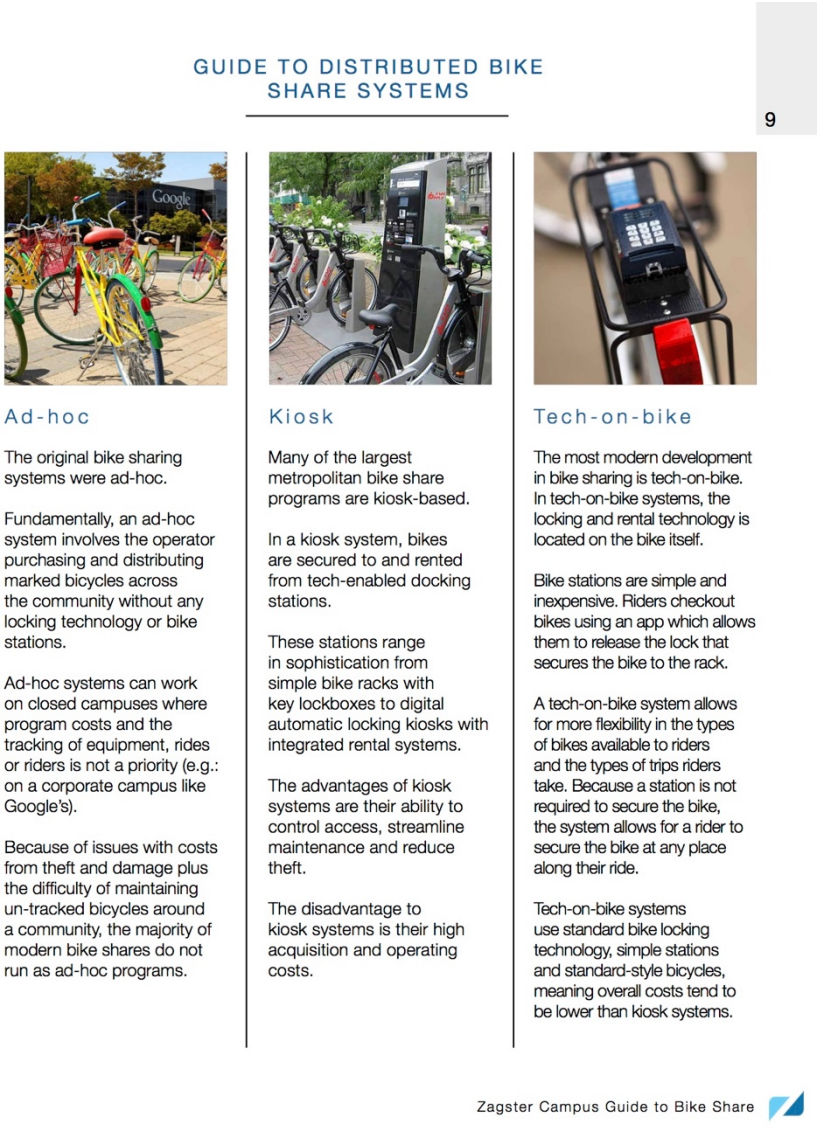
Figure 3

Technological System: Type and Number of Bicycles

With the narrowed scope, the conclusion was reached that an initial quantity of ten bicycles would suffice for Lafayette's small-scale campus. Through analysis of bike-share systems at other colleges, it was determined that for Lafayette, ten bikes would suffice, and following success of the program, more bikes could be introduced. For example, Lehigh University, which in culture and size, recently began a beta bike-share program with ten bicycles. Because of the hill that Lafayette is built on, the most favorable kind of bicycles would be small multi-gear bikes. This would provide assistance for pedestrians riding up and down the rigorous hills.

Technological System: Technology

One important question that bike-share programs face before being implemented is "What type of system should be installed to ensure efficient and reliable bicycle use?"



GUIDE TO DISTRIBUTED BIKE SHARE SYSTEMS

9

Ad-hoc

The original bike sharing systems were ad-hoc.

Fundamentally, an ad-hoc system involves the operator purchasing and distributing marked bicycles across the community without any locking technology or bike stations.

Ad-hoc systems can work on closed campuses where program costs and the tracking of equipment, rides or riders is not a priority (e.g.: on a corporate campus like Google's).

Because of issues with costs from theft and damage plus the difficulty of maintaining un-tracked bicycles around a community, the majority of modern bike shares do not run as ad-hoc programs.

Kiosk

Many of the largest metropolitan bike share programs are kiosk-based.

In a kiosk system, bikes are secured to and rented from tech-enabled docking stations.

These stations range in sophistication from simple bike racks with key lockboxes to digital automatic locking kiosks with integrated rental systems.

The advantages of kiosk systems are their ability to control access, streamline maintenance and reduce theft.

The disadvantage to kiosk systems is their high acquisition and operating costs.

Tech-on-bike

The most modern development in bike sharing is tech-on-bike. In tech-on-bike systems, the locking and rental technology is located on the bike itself.

Bike stations are simple and inexpensive. Riders checkout bikes using an app which allows them to release the lock that secures the bike to the rack.

A tech-on-bike system allows for more flexibility in the types of bikes available to riders and the types of trips riders take. Because a station is not required to secure the bike, the system allows for a rider to secure the bike at any place along their ride.

Tech-on-bike systems use standard bike locking technology, simple stations and standard-style bicycles, meaning overall costs tend to be lower than kiosk systems.

Zagster Campus Guide to Bike Share

Figure 4

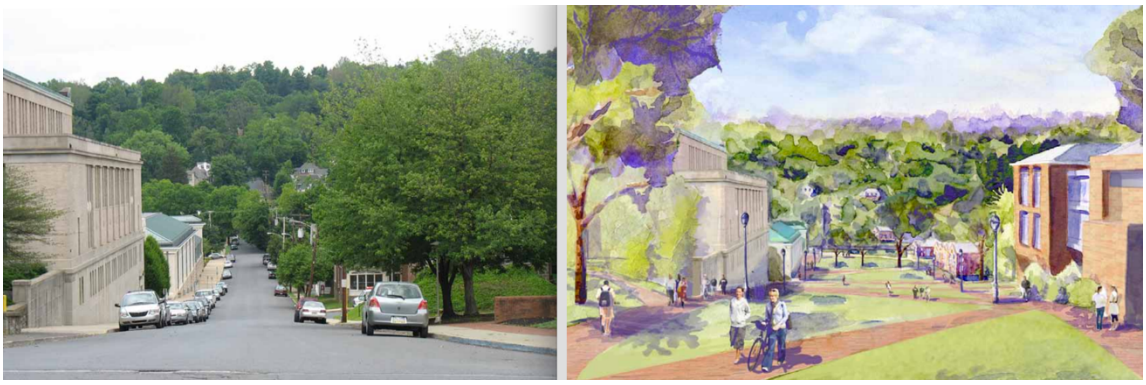
The image above, provided by Zagster, describes the three main types of bike-share systems. After conducting research on each of the three types of systems above, proposed solutions include one altered Ad-hoc system conducted by Lafayette and two outsourced tech-on-bike systems. In assessing technologies to implement, we prioritized systems and methods that will allow students to make intermittent stops with their use of the bicycle. While the outsourced solutions are both tech-on-bike systems, which will allow the integration of phones and data collection, the DIY solution offers a low-tech approach that will accomplish the same goal and save a substantial amount of money.

Infrastructure and Demand

The last official Lafayette College Master Plan, published in 2009, states the following in regards to biking on campus:

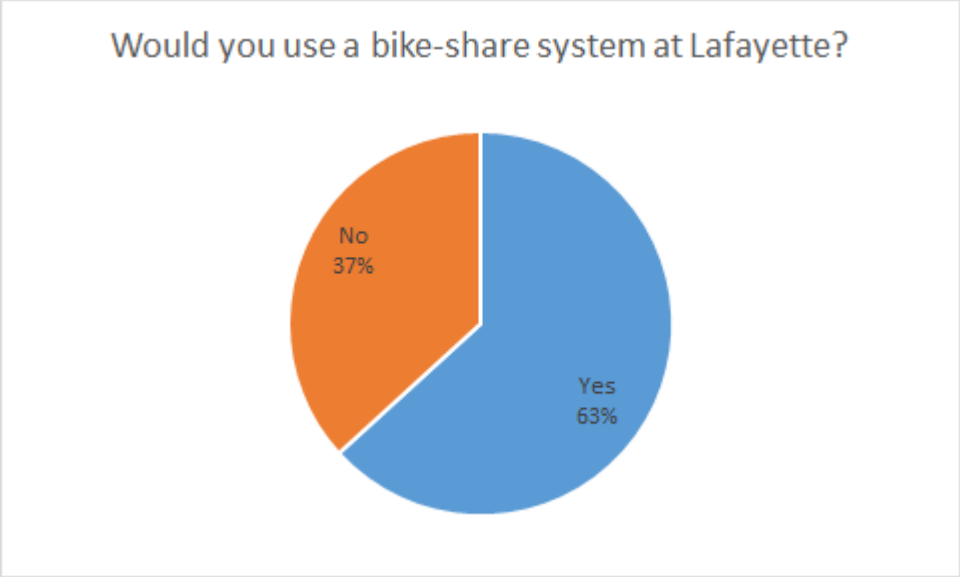
> Bicycle use was considered by the planning team as one component of an overall Transportation Demand Management (TDM) program. TDM is an effort to limit the number of vehicles on campus through incentivizing measures such as carpooling, biking, and walking. The campus has no formal TDM program, but the College does support a relatively strong ethos of environmental awareness and sustainability within its community. As changes proposed in the Master Plan are implemented, the College should continue to reassess opportunities to encourage biking (32).

As shown by the Lafayette's official statement, key administrators recognize the benefits of increasing bicycle use on campus. So much so in fact, that one of the images in the report, featured below, depicts the removal of roads and the substitution of paths. Additionally, a bicyclist is pictured directly in the front of the rendering, showing the College's future interest in biking as a main method of transportation. However, it is unfortunate that the master plan does say that Lafayette does not actually have a sustainable Transportation Demand Management program. On the other hand, successful implementation of any system arguably hinges solely on two factors: infrastructure and demand. Lafayette, at this point, now has both the infrastructure and the demand to successfully implement a bike-share system.



Figures 5 (left) and 6 (right)

Demand is again the second factor for successful implementation of a system. As seen on the figure below, a survey done in Lafayette College showed that over two-thirds of respondents (which included students, faculty and staff) said that they would use a bike-share program if it was available. Reasons for possible use were cited as, "recreation," "quick trips between buildings," and "going to downtown Easton."

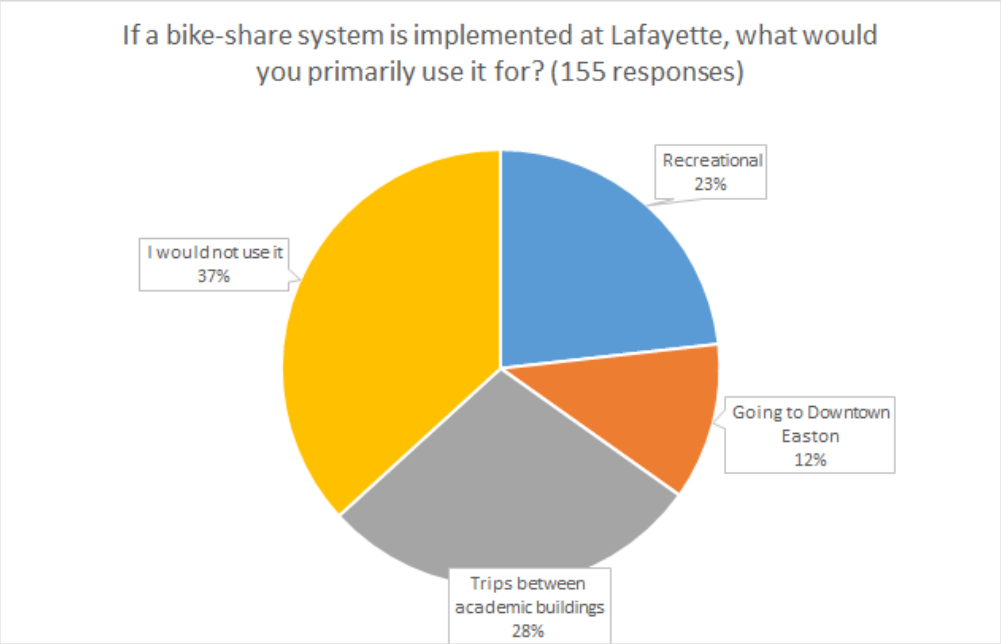


Survey was answered by over 150 Lafayette community members (i.e. students, faculty, staff)

Figure 7

There is substantial enthusiasm and a clear demand for a bike-share program on campus. To quote one student: "if we were going to donate $2,500 [on silly one-day event], I think we can get a bike share program…people will actually use it." The student, and bike-share advocate, was referencing an impromptu initiative in which Lafayette College offered to give $2,500 for an event during Lafayette-Lehigh rivalry week. One thing for sure is clear, Lehigh (which already has a functioning bike-share system) is beating Lafayette in its sustainability practices. In the 2015 fall semester, Lafayette College community members successfully led a sustainability rally demanding the college improves its sustainability efforts. A bike-share system would show the Lafayette community that its sustainability demands are being heard.

A bike-share system provides Lafayette College with a sustainable system that will be used by individuals. As seen on the graph below, community members plan on using a bike-share system in three main ways. As expected, running quick errands between academic buildings is the primary fashion individuals will use this system. An example may include a student or professor borrowing a bicycle to quickly move between buildings. In addition to running quick errands, 23% of respondents said they would primarily use the system as a means of recreation. For example, a sustainability club may host a bike tour of College Hill. Lastly, and surprisingly, over ten percent of respondents cited "going to Downtown Easton" as their primary reason for using a bike-share system. This is positive news as it shows that there will be reason to continue expanding the system by installing additional stations in Downtown Easton.

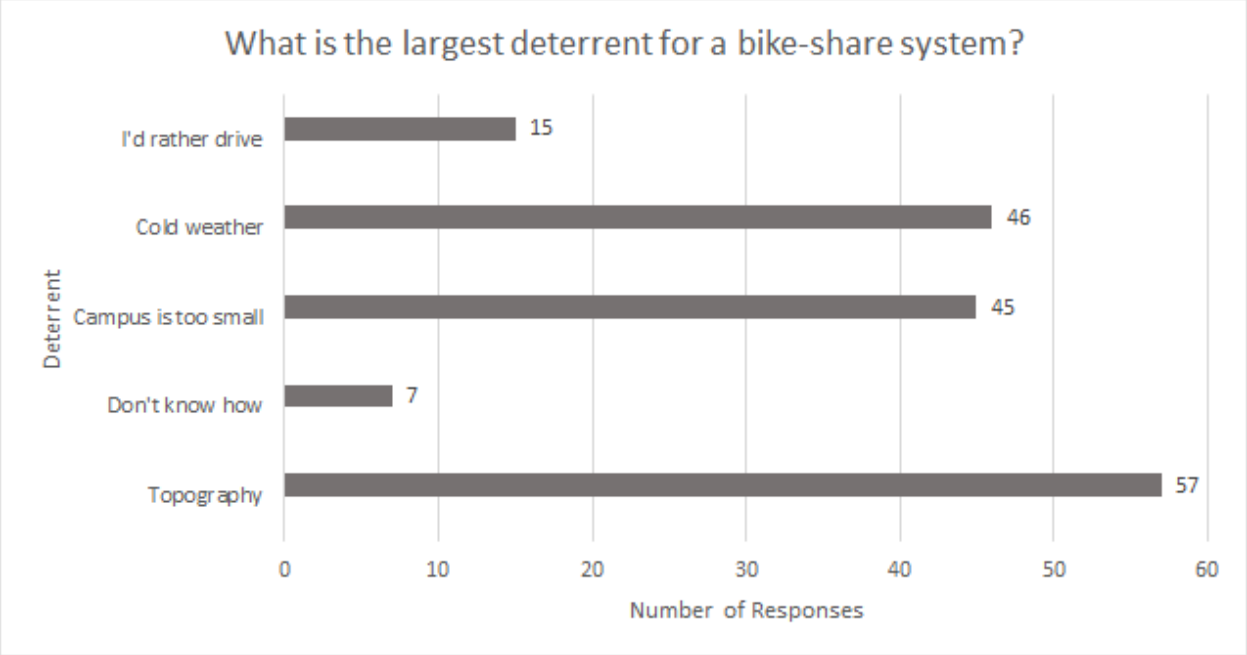


Survey was answered by over 150 Lafayette community members (i.e. students, faculty, staff)

Figure 8

Climate

To collect concrete data on student and faculty views on a bike-share system, a survey was distributed to Lafayette College community members. As shown in figure 5, the largest deterrent for a bike share program is the topography of the campus. This factor is very predictable since the steep hills, such as those on College Avenue and Sullivan Road, are particularly challenging. The second largest deterrent is the weather. In particular, College Hill has several uncontrolled environmental challenges. Nearly all students, the group that makes up the majority of the Lafayette College community, are only here for about 32 weeks out of the year (about eight months). Out of these 32 weeks, around 12-14 of them are expected to be cold, with snow, sleet, and freezing rain.



Survey was answered by over 150 Lafayette community members (i.e. students, faculty, staff)

Figure 9

A Queen's University study reveals several useful insights to decrease the likelihood of individuals seeing cold weather as a deterrent. In particular, the study cites several consequences of cold weather as unsafe conditions. This 2012 study, performed in a college town, is particularly applicable to the socio-environmental context of Lafayette. In short, the "paper examine[d] potential barriers to biking among college students" (Agarwal, North 151). The authors explain that "factors that influence an individual's decision to make a trip by bicycle can be divided into two categories: personal characteristics, [depicted in the chart below by sex,] and environmental characteristics, [depicted in the chart below by weather]" (Agarwal, North 153).

Firstly, the study reveals that weather barriers present a serious challenge to bike-share systems. As seen below in figure 6, 82.50% of students surveyed cited "cold weather" as a barrier for biking. Interestingly however, students cited several consequences of cold weather (too much snow; snow onto the being ploughed onto the road should; ice on roads) as separate barriers to biking. Snow on the side of the road will discourage students to bicycle on campus because the road shoulder is

"where bicyclist usually ride in absences on a bicycle lane… Snow ploughed off both the roadway and the sidewalk often collects for days on the road shoulder. As a result, bicyclists find themselves riding closer to the moving traffic" (Agarwal, North 164).

If a bike-share system is implemented at Lafayette, the administration should consider removing these barriers by deploying a greater number of cleaning crews. In doing so, "more students would be inclined to bicycle during the winter" (Agarwal, North 164). Further, as seen on the chart below, a greater percentage of women agreed that they see "too much snow" and the "risk of slipping on ice" as deterrents. Action must be taken, especially to ensure women feel equally as comfortable as men using the bicycles.

Barrier	Percentage of respondents				
	Sex	**Disagree**	**Neither Disagree Nor Agree**	**Agree**	**Total**
Cold weather	Male	8.5	6.4	85.1	100
	Female	19.6	0	80.4	100
	Total	**14.6**	**2.9**	**82.5**	**100**
Too much snow	Male	8.5	6.4	85.1	100
	Female	5.4	0	94.6	100
	Total	**6.8**	**2.9**	**90.3**	**100**
Snow is ploughed onto the road shoulder making the route feel less safe	Male	2.1	12.8	85.1	100
	Female	1.8	12.5	85.7	100
	Total	**1.9**	**12.6**	**85.4**	**100**
Risk of slipping on ice	Male	10.6	10.6	78.7	100
	Female	7.1	3.6	89.3	100
	Total	**8.7**	**6.8**	**84.5**	**100**

Figure 10: Obtained from Agarwal, North

Comparing Bicycle Cultures

Bicycle culture has changed dramatically in the United States. According to the U.S. Census, the number of adults that bike to work in the United States increased 60% from 2004 to 2012 (488,000 in 2004 to 786,000 in 2012). This increase is so drastic that it "is the largest percentage increase of all commuting modes tracked by the 2000 Census and the 2008-2012 American Community Survey" (ibib). Since this is the largest publicly available pool of data, it can be used to make inferences about the general population.

The macro-American trend of increased bicycle-use holds true for Easton. According to data obtained from the United States Census, only 0.10% of the Census Tract 141 (which includes College Hill) population bicycled to work at the brink of the millennium. This number increased to 0.60% in 2012. In other words, the use of bicycles in College Hill for commuting to work has increased by 600%. This means that College Hill, despite its sloping topography, is faring well in terms of bicycle travel.

More importantly, the data shows that the use of bikes on College Hill has actually been increasing at a faster rate than the national average. This is in stark comparison to the figures of Census Tract 111 of Northampton County, which includes Lehigh University. According to data from 1990, 2000, and 2013, zero percent of Lehigh University's community members reported using a bicycle as a method of traveling to work. Nevertheless, Lehigh University successfully partnered with Zagster to implement its own bike-share system in October, despite a lack of historical use and a lack of infrastructure. This alludes to the point that Lafayette should be able to implement a similar system, especially considering that Lafayette already has community members that use bicycles, bike racks, and paths across campus. In short, Lafayette has more favorable conditions than Lehigh did when they installed their bike-share system.

Safer Conditions for Students

These features below were produced as a result of the College's initiative to transform Lafayette into a walking and biking campus rather than driving one. As previously mentioned in this report, following this campaign several of the roads on campus were made into aesthetically pleasing brick paths.

Figures 11 (left) and 12 (right): Area in front of Pardee Hall in 2009 and today, respectively

In under one decade, the campus has become friendlier towards bicycle usage. The removal of roads is crucial for the success of a bike-share program for several reasons. The first reason being that the removal of roads, means that students will not be able to drive to the destinations that only have paths. Secondly and more subtly, the removal of cars, may make students feel much safer. In fact, 79.60% of students surveyed about conditions that will encourage them to bicycle more, cited, "bicycle paths that are physically separated from automobile traffic" as a factor (Agarwal, North 161). In addition, 85.40% of students surveyed also cited, "enforcing that cars do not park in bicycle lanes" as another policy change that would encourage them to bicycle more. In other words, two very successful policy changes deal with removing motor vehicles from biking areas.

As mentioned earlier, Lafayette, through its *Campus Master Plan,* already accomplished the task decreasing number of roads with cars and seeks to expand this effort down Hamilton Street. A bike-share system being implemented in the calendar year of 2016 will be able to leverage this continued political and social momentum towards sustainable and safe modes of transportation.

Another mitigating factor is that a large percentage of the target population for the bike-share program will be composed of college-aged students. Community members from age 16 to 24 are most likely to use a bicycle as a means of transportation (McKenzie 11). Since most Lafayette College community members are students, most potential users will fall within the age range that uses bicycles the most.

Solutions

To implement a bike-share system at Lafayette, we are proposing three possible solutions. The first is Lafayette's own "Do-It-Yourself" program, called a "Bike-Library." This consists of Lafayette handling the research, surveys, purchasing the bikes, installing a central docking station, adding a role to the job of the students who run Skillman's front desk, and contacting local bike shops for maintenance as necessary. The second and third solutions are both outsourced options: Zagster and Viacycle. These are advantageous because they take care of most of the legwork and help overcome the challenges of implementing a potentially very expansive system. The disadvantage to an outsourced solution, however, is cost.

Zagster

Figure 13

Zagster offers turn-key solutions - solutions that take care of virtually everything, including materials, implementation, and operations - for communities that want to benefit from a bike-share program. According to CEO Timothy Ericson, Zagster strives to replicate with bikes what Zipcar has done with cars. Since its founding in 2007, the company has grown continuously and has experienced great success. As of July 2015, it raised over $3.5 million from venture capitalists, bringing its total funding to over $6 million (Kolodny). Zagster has partnered with businesses and corporate campuses, universities, and residential properties; some notable partners include General Motors, Duke University, and Lehigh University. Zagster is truly an expert in this field, as there are very few competitors that match Zagster's experience in the market.

By offering a turn-key solution Zagster ensures that partners implement a cost-effective system that will meet administrative goals, please users, and place little to no burden on the surrounding community. Further, Duke University Student Government president, Lavanya Sunder mentioned

that they “love the fact that Zagster manages the entire program, from the technology, to customer service and bike maintenance. It allows us to offer this program without huge costs" (Williams).

Zagster recognizes that a program that may work at Duke or at Lehigh may not work at Lafayette. Lafayette is subject to its own unique medley of socio-technical, economical, policy, and environmental forces. As a result, if Lafayette were to partner with Zagster to implement a bike-share program on campus, Zagster would send representatives to gather information about Lafayette’s infrastructure along with its technical and non-technical environment and goals. Once Zagster obtains all of this information, it will develop a bike-share program specifically tailored to fit Lafayette’s social climate, environmental and geographical features, and policy goals.

How Will It Work?

Users are the central component to any bike-share system. As a result, for a bike-share system to be used, it should feature an easy interface and provide users with unique incentives.

As seen in the image above, the Zagster system works with very simple technology that will be readily available to all Lafayette College users. To check out a bicycle, the user would simply obtain a checkout code from a mobile app and type it into the chosen bicycle’s keypad.

Further, Zagster's system allows users to make intermittent stops on their journey, while the bike is checked out. For example, a user could ride to a local restaurant, visit a friend, and simply lock the bike with the provided U-lock to allow for safe stops while running errands.

Close-up of keypad

Figures 14 (left) and 15 (right)

The System

Apart from the users, the Zagster system comprises of several components which include:

1. Bicycles
2. Docking Stations
3. Software
4. Host Institution (i.e. Lafayette College)
5. Zagster Operations Team
6. Local Maintenance crew

Figure 16. Some of the key features of the Zagster bicycle

The physical Zagster bike several key features that make it safe and useful to a wide range of individuals. The adjustable seat ensures that any user, regardless of physical characteristics will be able to use Lafayette's Bike-share system. The U-lock and active lights are two critical safety features that will allow users to venture outward while preventing theft and promoting safety through increased visibility. The seven gears will assist users in navigating through Easton's hilly topography. Additionally, the fenders and chain guard allow easy cleaning. Finally, the basket in front of the bicycle allows students to transport items such as books or groceries.

The docking stations and software help to increase visibility of the bicycles on campus and to ensure security when docked. By having a docking station, users will know where they can always find an available bicycle. In addition, the dock station has several points of contact locking with the bicycles that will prevent the risk of theft. The software program will inform users of the number of bikes available at any given time and will allow the Zagster operations team to research any insightful trends that could offer insight as to how to grow the program.

Lafayette Bike - Library (DIY)

We have established that Lafayette College is a relatively small educational institution in which community members should not have the need for a car. The college has been trying to transition into a more walking friendly campus; examples of this including transforming the roads in front of Pardee and Anderson Courtyard into a brick pathway and lawn, respectively. Implementing a bike-share system on campus would further enforce the College's mission; however, while outsourcing a company can ensure for a successful system, the idea of creating their own system should not be disregarded. Schools such as New York University (NYU), have successfully created and maintained their own bike systems, and due to their success, are currently expanding them. Looking to these schools for guidance will assist Lafayette in implementing its own, equally successful bike-share system.

NYU's bike-share system was operated by two graduate students and was comprised of thirty refurbished bicycles and a software system that enabled students to swipe their card to check out a bike from the U-locked docking station. Additionally, students can reserve bikes through a web-based system.

ORIGINAL 2008 NYU BIKESHARE LINE-ITEM PROPOSAL

ITEM	UNIT COST	QTY	TOTAL ITEM COST
Hoop Racks + ship + install	$99.00	15	$1,485.00
Helmets	$279.80	20	$5,596.00
Bike locks	$9.39	35	$328.65
Headlights	$5.99	27	$161.73
Taillights	$5.99	40	$239.60
Pedal Wrench	$18.49	2	$36.98
MTB-7 rescue tool	$8.79	5	$43.95
Air gague 10 count	$24.99	1	$24.99
Tire lever set	$2.29	4	$9.16
Spoke wrench set	$4.99	1	$4.99
12" crescent wrench	$6.69	1	$6.69
Metric wrench set	$26.99	1	$26.99
Utility knife	$7.59	1	$7.59
Park air pump	$18.49	2	$36.98
Truing stand	$33.99	1	$33.99
Paint	$26.47	1	$26.47
Rustproof coating	$37.88	1	$37.88
Food for workshops	$26.12	1	$26.12
Bike rack	$252.00	1	$252.00
Biria 1-spd Easy Boarding bikes	$205.50	30	$6,165.00
TOTAL			**$14,550.76**

Figure 17

Shown above in Figure 17 is a complete list of costs for NYU's system. This was financed primarily through a grant of $13,000. Today NYU's bike share program has expanded to several different areas in Manhattan along with one in downtown Brooklyn. NYU's success is a positive reinforcement that it can be done, especially since NYU's 54,000 students far outweighs Lafayette's 2,500; Lafayette would not need nearly as much funding or bikes to create a successful program.

How much will it cost and how will it work?

There are several possible Do-it-Yourself style solutions available. One is a checkout system such as that at NYU in which individuals use their college ID cards to check out a bike from the docking station. Another solution is for a bike could be treated the same way as checking out a book; the user simply asks the student behind Skillman's front desk to rent a bike for the day.

Concerning funding, NYU was able to create a free membership for its students and faculty members, but because Lafayette is such a small community there may need to be a small surcharge for membership, ranging anywhere from ten dollars for the semester to twenty dollars for the semester; however, in comparison to the $200 per semester needed to park a car on campus, this becomes a financially sensible option.

The optimal location for such a system is at the already-installed bike rack in front if Skillman library. This is ideal because it is close to many of the academic buildings, the quad, dining halls, and the student center and as stated before, the student librarians could check out the bikes to students the same way as a book. In terms of cost, this system ranges widely primarily based on the quality of the bikes. If the college would like to purchase new bicycles the cost roughly ranges anywhere from $200 to $1,000. Lafayette would also need to create a housing system for bikes along purchasing utilities such as helmets, a bike rack for the hub, locks for the bikes along with several tools for on campus quick fixes. Overall the college will be looking as a roughly estimated cost of $10,000 for a self-run and implemented bike-share system. Finally, in terms of maintenance, Lafayette would have to either hire a full-time mechanic or establish a relationship with a local bike shop. Since such an arrangement could potentially be very expensive, Lafayette could build a shed or housing for the bikes to protect them from the elements, thereby reducing repair costs.

Viacycle

Figure 18. Image from: ViaCycle

Basic Information:

Viacycle combines new ideas in transportation with cutting edge IT to give users the opportunity to travel where and when they want. The company stresses that each system is tailor-made to best fit the client's needs, and that the bikes are easy to deploy, manage, and use. Viacycle has implemented three bike-share systems thus far: Georgia Tech, George Mason, and Las Vegas.

Technical Analysis (How it Works):

Viacycle sets up networks of bicycles around the campus using pre-existing bike racks, meaning that no kiosk-type system is needed – only the bikes and the Viacycle technology system. Users can go online or use a mobile app to see the locations and check the availability of bikes in their area. Because bikes will be located at central hubs on campus, users will always know where to find an available bike. To check out a bike, users can simply use the mobile app or text/call Viacycle.

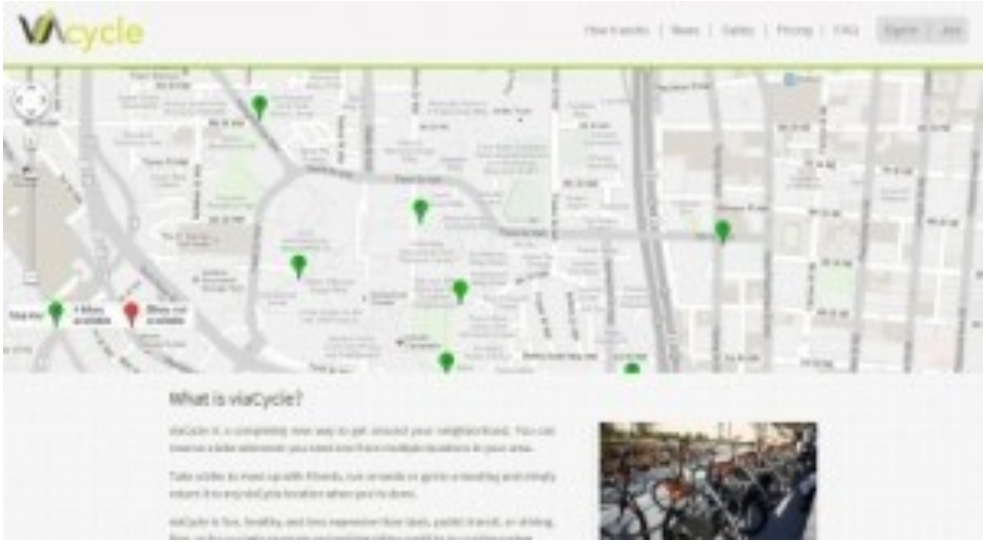


Figure 19: A web display showing locations and availability of Viacycle's bikes

Another impressive feature of Viacycle is that the user has the ability to leave it parked anywhere, as long as it is returned to the bike rack / docking station at the end of the trip. This is made possible because the bikes have a locking mechanism built in, allowing safe and secure storage no matter the location. Only the user will have access to the bike once parked, therefore preventing theft as well. This feature is particularly useful in the event that the user needs to run a quick errand while riding a bike, such as shopping for groceries or visiting a friend around campus.

The bicycles also have a lighting feature to display availability. A green light means the bike is available for use, while a red light means the bike is checked out. Yellow means the bike is still checked out but is not currently in use, as described above. The bike will be locked, awaiting your return.

Figure 20: A closer look at Viacycle's "tech-on-bike" system.

Economic Analysis

	Current Operators	viaCycle
Bicycle (3-speed)	$1,168	$1,500
Kiosk Terminal (card reader / GUI)	$11,022	
Bicycle Dock (single bike dock)	$850	
Station Component Cable	$118	
Kiosk Platform	$1,100	
Station Battery	$203	
Kiosk Spare Parts	$403	
Installation Cost (per station)	$3,000	
Public Right-of-way Permit	$1,000	
Use permit/site app	$5,000	
Use permit/site app additional per station	$300	
Liscense Agreement Property Owner	$2,000	
Station Site Plan Development	$2,500	
Concrete Pad Install 7' x 35'	$6,000	
Concrete Pad Install 7' x 45'	$7,500	
Concrete Pad Install 7' x 55'	$9,000	
Concrete Pad Install 7' x 65'	$11,000	
Delineator Installation (per station)	$200	

Figure 21

As seen in the chart above, each Viacycle bike will be one flat cost of approximately $1,500. Note that there are no other expenses, as opposed to the complex cost structure of current operators – this is because of Viacycle's "tech-on-bike" system and use of normal, pre-existing bike racks as opposed to a custom-designed kiosk. For 10 bike on Lafayette's campus, the total cost of the bikes is $15,000. There will also be additional costs for mobilization, labor, and maintenance thereafter.

Evaluation

Evaluative Criteria

The proposed solutions will be evaluated by using four criteria: cost, reliability, ease of implementation, and ease of use. These metrics were chosen because they are the most important factors when evaluating any alternative.

Needless to say, cost is an important metric to evaluate. Lafayette must be careful about where its endowment is allocated, because the projects need to have a significant positive impact on the college, students, faculty, staff, and the surrounding community. Further, any projects Lafayette chooses to pursue ideally will not impact funding on any other initiatives from other departments.

Reliability, the second evaluative criteria, was chosen for many of the same reasons as cost, as the two are directly related. An unreliable product will create a large magnitude of maintenance and repair costs, thus adding to the overall cost of the project. Additionally, bicycles for an unreliable product may be consistently out of service making it inaccessible to users. This also results in the overall decrease of the systems effectiveness. Consequently, when there is a lack of bikes due to poor reliability, either more bikes will need to be purchased in anticipation of breakdowns, or more money will have to be spent to hire a mechanic for constant maintenance. Clearly, implementing a tested, reliable system would minimize these risks and would aid in an effortless implementation of this bike-share system at Lafayette.

The third evaluative criteria is ease of implementation, which by definition represents the level of difficulty faced to put each bike-share solution in place at Lafayette. This is an important factor because depending on the alternative, the level of ease can determine how feasible it may be. In some instances, implementation may be as simple as paying a fee, while for others new employees may need to be hired, contracts with local businesses arranged, infrastructure built, and more. This criteria will assess what is needed for each solution.

The fourth and final evaluative criteria used is ease of use. This includes features such as the location of the central bike hub on campus, ease of reserving / picking up a bike, being able to see how many bikes are available or where they are located, maintenance, timeframe for implementation, and more. This is an important factor to consider because it is directly correlated to how often this system will be used by community members.

The three potential solutions will be rated on a scale of 1 to 3 for each of the evaluative criteria above, with 3 being the best and 1 being the worst rating. A simple 1-2-3 system is very concise and will provide clear "winners" and "losers" for each type of criteria. Finally, a weight of 1.5 has been added to the cost criteria, as cost is likely to be considered the most important metric for Lafayette. This is because all three solutions will essentially create the desired bike-share system; but, the cost between them differ significantly. Furthermore, many individuals, namely administrators of Lafayette who control financing, will care most heavily about the bottom line. The metrics of reliability, ease of implementation, and ease of use will remain with a weight of 1.

Scoring

	Cost (x1.5)	Reliability	Ease of Implementation	Ease of Use	Total
Lafayette Bike-Library	4.5	1	1	2	8.5
Zagster	1.5	3	3	3	10.5
Viacycle	1.5	1	2	3	7.5

Explanation of Scores

Zagster's turn-key solution will be specially built for Lafayette and therefore will be reliable, albeit more expensive than the others. As seen above, it earned the highest score and for that reason, we recommend this solution.

Part of Zagster's success stems from its ease of use and ease of implementation. The Zagster system is proven, easy to use, and allows for both stops and long trips. In addition, since Zagster handles every facet of the system, Lafayette will be able to stay hands-off besides providing a monthly payment. Thus the college can live up to its sustainability promise without having to hire extra staff, purchase new materials, or needing to burden the community. Therefore, Zagster a score of 3 for both ease of implementation and ease of use.

In a short number of years, Zagster has managed to grow significantly, increasing its number of university partners from one to now greater than eight. All of Zagster's systems are succeeding, and as such Zagster seems like the most reliable option. In addition, Zagster will perform regular maintenance to the bicycles and offer advice on how to run an effective program. Critically, Zagster recently established a partnership with Lehigh University which features many similar environmental factors as Lafayette College and a more challenging topography. For these reasons, Zagster is awarded the top score in terms of reliability: 3.

Lastly, such an involved and reliable service must come at a price. After several calls and emails with employees at Zagster, we received a high-level cost estimate for a two-year program with ten tech-on-bikes bicycles. The first year is expected to cost as much as $20,000, including costs for implementation, labor, materials, and operations. Following the implementation in the first year, the system will cost about $15,000 / year. Seeing as this is the most expensive program to implement, Zagster received a 1 for cost.

The Lafayette Bike-Library received the second highest score between the three choices. This is mainly because it received low scores for the implementation, and reliability. These low scores stem from Lafayette needing to take the system from start to finish itself. This would require many hours of work for current Lafayette employees, and most likely some new hires as well. Examples of necessary steps include building a protective housing for the bikes, conducting maintenance and repairs either itself or through a partnership with a local bike shop, and surveying the population to evaluate the system's effectiveness and it advances.

Despite low scores for ease of implementation and reliability, the DIY solution had the best score for cost. The final cost estimate of the DIY system is approximately $10,000; however, due to the

wide range of costs for the bikes themselves ($250 to $1,500), this number is flexible. Based on the terrain of Lafayette's campus, the bikes would need several different gears to overcome hills. Thus, the cost per bike is estimated at about $500. In addition to the bikes themselves, there will be the cost for accessories such as helmets and lock systems. Again, calculating the total for these parts of the system, the final cost is roughly $10,000, excluding the protective housing for the bikes. In terms of the ease of use criteria, the DIY system received the medium score of 2, because while the system does not incorporate technology, the checkout system in the library is easy and convenient since there is already a position for the front desk librarian, and including bike checkouts would not be a large burden to the position.

Viacycle was given a total score of 7.5, making it the worst of the three proposed solutions. Ultimately, besides ease of use, this was generally a weak alternative. In terms of economics, Viacycle costs $15,000/year for ten bikes, just shy of Zagster, but does not provide maintenance. Therefore, if implemented, Lafayette would be forced to either hire a mechanic to conduct necessary repairs or establish a relationship with a local bike shop; either way this is an extra expense. Further, Viacycle's reliability is questionable, as the company has only implemented three systems, and only two of which are colleges: Georgia Tech, George Mason, and the city of Las Vegas. Additionally, because Viacycle does not provide maintenance and repairs, it would need to be outsourced, again by either hiring a mechanic at Lafayette, or working with a local bike shop. Finally, there is a substantial lack of information about Viacycle on the colleges' websites, and when contacted three times by phone and once by email, no response was received. Thus, Viacycle was given the bottom score for reliability.

For ease of implementation, Viacycle was given a score of 2. This is because while Viacycle does fully conduct implementation, there was again a lack of information and previous reviews from previous universities. Finally, for ease of use Viacycle was awarded the top score of 3, because it is truly the easiest option to use on a daily basis. With the tech-on-bike system and ability to lock up anywhere and maintain possession of the bike, to view locations and availability of all bikes in the system, and use of a mobile app, Viacycle's system is carefully thought-out and intuitive. However, despite Viacycle's success in ease of use, ultimately the drawbacks were too great and this solution fell to last place.

Conclusion

Summary

After understanding the problem of transportation on Lafayette College's campus, defining a scope to understand the cultural and political aspects of the problem, and understanding the challenges and mitigating factors associated with implementing a bike-share system, a sustainable conclusion was created. By assessing each of the three potential solutions through the evaluative criteria of cost, reliability, ease of implementation, and ease of use, it was concluded that outsourcing to Zagster is the optimal solution for Lafayette's problem of having no formal transportation demand management system, despite supporting environmental awareness and sustainability. By implementing Zagster's system, Lafayette will be able to formally make a positive movement towards a community that facilitates sustainable transportation methods.

Moving Forward

Advancing into the future, the Zagster bike-share solution will be proposed to several parties, including the newly hired Campus Sustainability Director, the Planning Committee, and Public Safety. These groups are all important in the implementation of this bike-share system, as they will promote sustainability and environmental friendliness, get the project moving forward through the policy process model, and ensure cyclists' safety on campus, respectively.

Next, funding must be raised. This could happen primarily through a capital campaign, grants, or private donations. Once each of the above parties approves and promotes this project, and the necessary funds are raised, Lafayette will change the campus environment, ensure a greater level of students and faculty safety, and provide a greater means of transportation across College Hill.

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