Getting Into Gear:
The Prospect of a Campus Bike-Share System at Dalhousie University

SUST 3502 Environmental Problem Solving Two: The Campus as a Living Lab

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2. Executive Summary

Dalhousie University currently funds a bike rental and repair facility known as the Dal Bike Centre. Accessibility and expansion of this center are restrained by its limited number of operation hours, as well as its inconvenient location and lack of student recognition. A third generation or 'next generation' Bike Share System (BSS) would provide a system of sustainable transportation that can be more readily accessed by all students and other members of a community. This study is geared towards discerning the determinants towards utilization of the current Dal Bike Centre, and furthermore to determine the plausibility of integrating a third generation BSS into Dalhousie's three Halifax campuses.

After distributing closed or structured questionnaires to students across campus, we identified that the main factors inhibiting use of the current Dal Bike Centre were in fact its inconvenient hours and location. In addition to this, we concluded that the majority of students were in favor of the implementation of a third generating BSS with a small annual fee of $25. The findings from this research suggest that the implementation of a third generation BSS would be successful on the Dalhousie campus as students would be willing to pay for and utilize the program. However, factors that affected individual's answers included their faculty of study, type of current transportation to and from campus, as well as the distance of residents from campus. This report will entail a more descriptive analysis of the previously stated findings and conclusion of the research, however further research will be necessary in order to formulate a more decisive conclusion for future implementation.

3. Literature Review

3. 1. What is a Bike-Share System (BSS)?

A third-generation BSS is a system that provides numerous members of a community access to affordable, sustainable, and reliable active transportation. Paying members, or one time users who pay via credit card can travel throughout the city of Halifax checking out and returning bikes to numerous docking stations located in convenient places around the city. "A third—or next-generation system entails […] (1) unstaffed bike stations, (2) software technology to keep track of bikes, (3) technology for monitoring the bike at the bike station (in individual docks) or on the bike itself, (4) [and] heavier duty bikes" (Kaplan & Knowles, 2015, 2015).

BSSs offer immense benefits to communities with both preexisting and low access to bikes (Kaplan & Knowles, 2015). As bicycle use increases, motor vehicle dependence and fossil fuel consumption decreases, resulting in less traffic congestion and carbon dioxide (CO2) emissions (Fishman, Haworth & Washington, 2012; Kaplan & Knowles, 2015). Bryde et al. (2015) explain that "a move towards sustainable mobility necessitates a reduction in the inefficient use of private vehicles and an increase in access to environmentally sustainable transport, especially for communities with a high percentage of low-income households" (p. 124), or those with low fixed budgets such as university students. Increased bicycle usage also

offers health benefits (Bryde, Duan, Zhang, & Zhang, 2015; Fishman et al., 2012; Kaplan & Knowles, 2015). It is noted by Kaplan & Knowles (2015) that "regular riders are healthier and enjoy a greater connection to the environment than motor vehicle passengers" (Kaplan & Knowles, 2015, p. 65). Bicycle riding is "environmentally-friendly, economically cost-effective, [and] a way to keep fit and healthy" (Bryde et al., 2015, p. 124).

3. 2. Benefits of Bike-Share Programs

A move towards modes of active transportation such as biking provided by BSSs can result in a multitude of benefits for universities, students, cities, and citizens alike (Kaplan & Knowles, 2015). A small shift towards biking can result in a decrease in overall traffic congestion within a city, while simultaneously improving the health and wellbeing of those who choose to participate in it (Duvall, 2012, as cited in Marshall, Duvall, & Main, 2016; Fishman, Haworth, & Washington, 2012; Kaplan & Knowles, 2015) An increase in biking has also been shown to reduce the costs associated with parking and transportation infrastructure (Kaplan & Knowles, 2015), as well as providing financial savings to those who choose biking over other forms of transportation (Fishman et al., 2012). Kaplan & Knowles (2015) note that providing bikes to students can benefit local businesses by providing easy transportation around cities. Increased bike traffic can expand the markets in which students' access by roughly three kilometers (Kaplan & Knowles, 2015). Other notable benefits include reduced use of fossil fuels and reduced carbon emissions (Fishman et al., 2012; Kaplan & Knowles, 2015). For example, since its conception in 2010, the 'B-Cycle' BSS in Denver, Colorado is estimated to be "responsible for 1.7 million fewer vehicle-miles travelled and 80,000 fewer gallons of gasoline consumed (Denver B-Cycle 2012, 2014; EPA 2013, as cited in Marshall et al., 2016, p. 135).

BSSs are relevant to your study because they represent the infrastructure model that we see playing a crucial role in the expansion of active transportation on and around Dalhousie University campus. BSSs are integral in making bikes accessible to the masses, including those who already own bikes, and those who do not (Kaplan & Knowles, 2015). They increase mobility, reduce use of fossil fuels, reduce CO2 emissions, reduce congestion on the roadway, reduce, increase physical wellbeing, and offer financial savings for users (Fishman et al., 2012).

3. 3. Barriers to Increasing Bike Use

In a study conducted at Kent State University, Kaplan and Knowles (2015) found that there is a gap between the desire to use bikes as a method of transportations, and their actual use. The reason for this gap is explained as impediments such as weather, infrastructure design, traffic, perceived safety, and the requirement of helmets (Fishman et al., 2012; Kaplan & Knowles, 2015). Kaplan & Knowles (2015) explain that environments and infrastructure not designed for biking can be hostile towards new bikers, often discouraging individuals from participating, forcing them towards others modes of transportation. When proper biking infrastructure such as bike lanes and storage facilities are implemented, participation in biking increases (Pucher, Dill, & Hundy, 2010, as cited in Kaplan & Knowles, 2015). Although infrastructure is important to increasing active transportation participation, policies that provide

access to bikes is actually one of the most effective methods of increasing participation (Kaplan & Knowles, 2015). Kaplan & Knowles (2015) note that "[o]ne of the most useful interventions is a program that delivers operating bikes for short-term use" (p. 64).

Raising awareness of BSSs can be the most challenging aspect of creating a successful system (Kaplan & Knowles, 2015). Kaplan & Knowles (2015) note that a main determinant of a successful BSS is demand, which can take significant time and resources to build. A lack of publicity and advertising can have an ill effect on BSSs, causing them to shut down due to low ridership (Kaplan & Knowles, 2015). This is an important point to consider, as our preliminary research shows that many Dalhousie University students are unaware of the services that the Dalhousie Bike Centre offers. Similarly, in surveys conducted at Kent State University, it was found that many students did not know the BSS existed, but showed keen interest once they were introduced to it, further stressing the importance of publicity and advertising (Kaplan & Knowles, 2015). Steady funding is also a significant barrier to BSSs (Kaplan & Knowles, 2015). BSSs require considerable initial investments, but also require long term funding for maintenance and monitoring (Kaplan & Knowles, 2015).

3. 4. Third Generation Bike-Share Systems at Kent State University: A Case Study

Third generation BSSs are unique for three main reasons (Kaplan & Knowles, 2015). First, they offer automated docking stations with card based payment mechanisms that do not have to be staffed by humans (Kaplan & Knowles, 2015). Second, they utilize GPS technology coupled with software to track their bike fleets (Kaplan & Knowles, 2015). And third, they utilize heavy duty bikes, often with internal chain systems which require less maintenance over the long term (Kaplan & Knowles, 2015).

Following the success of a second generation BSS in 2008, Kent State University in Kent, Ohio deployed a third generation BSS offering the aforementioned benefits over their previous system (Kaplan & Knowles, 2015). Due to the automated docking system, Kent State's new third generation system offered twenty-four hour bike rentals (Kaplan & Knowles, 2015). This feature allowed for increased availability, as second generation systems required employees to be present to check bikes out (Kaplan & Knowles, 2015). The new third generation BSS was accessed via membership based card systems, which cost students twenty-five dollars per semester, while the remaining costs were subsidized by the university and local property developers (Kaplan & Knowles, 2015). Furthermore, this third generation BSS employed by Kent State University allowed anybody to become a paying member by registering for the system online (Kaplan & Knowles, 2015). Also, one time users were able to check out bikes at the stations with their credit cards, which is beneficial to tourists or individuals visiting campus (Kaplan & Knowles, 2015). Fishman et al. (2012) explain that this element of spontaneity is essential to a successful BSS, allowing users to access a bike with no more than a swipe of their credit cards. Fishman et al. (2012) explain that "focus group participants were clear and consistent in their desire to be able to join on-the-spot, instantaneously, 24/7" (p. 695). Due to the GPS technology coupled with tracking software, third generation BSSs allow check ins and checkouts at different stations around the city, which makes the systems better suited to commuter needs, rather than just those of recreational users (Kaplan & Knowles, 2015). The

bikes were made available for a maximum period of three hours, at which point fees begin to incur on the user's account (Kaplan & Knowles, 2015). The logic behind this mechanism of fees is to ensure that bikes are more readily available for users, combating the common problem of unavailable bikes in second generation BSSs (Kaplan & Knowles, 2015). This time limit and the ability to check bikes in and out at different stations encourages users to use a bike for one leg of their commute, while checking out a new bike for their return (Kaplan & Knowles, 2015).

By implementing a BSS while simultaneously improving city biking infrastructure, Kaplan & Knowles (2015) note that between 2008 and 2012, bike traffic throughout Kent State University and nearby neighborhoods increased significantly. Estimates state that around the world, "bike-share programs have more than doubled the share of trips taken by bike" (Kaplan & Knowles, 2015, p. 64).

This case study, as well as similar projects that have been deployed at universities including Georgia Tech in Atlanta, Georgia and the University of Oregon in Eugene, Oregon have similar student populations to that of Dalhousie University, with 19,945 and 20,376 respectively (Kaplan & Knowles, 2015). Each of these universities has a fleet of 850 and 800 bikes in their BSS (Kaplan & Knowles, 2015). With 18,500 students enrolled at Dalhousie University, these are useful numbers to consider when designing a BSS for Halifax, Nova Scotia (Dalhousie University, n.d.). The case study of Kent State University demonstrates the successes that a third generation BSS can provide to Universities and cities at large.

4. Methods

Our group is proposing to expand the Dalhousie Bike Centre and implement a third generation BSS on Dalhousie's Studley, Sexton, and Carleton campuses. Introducing a BSS on campus will help us reach our goal of creating a more efficient and active university campus and atmosphere.

In sequence of implementing a program, we conducted research to determine the optimal way of expanding the Dalhousie Bike Centre. In order to gather information from the student population of the Dalhousie campus, we created and distributed a closed and structured questionnaire to students across Dalhousie's Halifax campuses. Our choice of this survey method was decided based on "the overwhelming number of unique benefits that are allocated with the technique" (Palys & Atchison, 2014, p. 143). The closed and structured questionnaire was chosen for our research method because with this method all participants received the same questions, worded in the same way, therefore preventing human error and skewing results when being completed. Prior to dispensing the surveys, we completed an Ethics Report Application; a copy of the completed application can be found in the attached PDF file 'Ethics Form'. A consent form will also be distributed alongside the survey (see Appendix E).

The questions on the survey were closed and structured categorical questions. The survey was offered in two forms, the first was a browser-based survey made available by 'Survey Monkey' and then shared by means of social media (e.g. Facebook and Twitter). We chose this as our first form since browser-based surveys have an increased effect "on the speed and

duration of the research process" (Palys & Atchison, 2014, p. 147), and in turn "can be much faster than comparable traditional designs" (Palys & Atchison, 2014, p. 147). The second form of the survey was distributed via hand as it was a pencil-to-paper survey. We selected this research method as our second survey approach since pencil-paper questionnaires allow for a range of basic analysis to intricate analysis when the survey data was obtained. The paper-to-pencil survey was distributed on each of Halifax's Dalhousie campuses at five different locations: the Mona Campbell (Studley Campus), the Life Science Centre (Studley Campus), the "B" Building (Sexton Campus), the Collaborative Health and Education Building (Carleton Campus), and the Tupper Medical Building (Carleton Campus). We estimated to distribute 50 surveys at each of these campuses, however due to our strive to be more accurate, we actually gathered 76 surveys from Carleton Campus, 65 surveys from Studley Campus, and lastly 50 surveys from Sexton Campus for a total of 191 pencil-to-paper surveys distributed in total. Originally, our group's goal was to collect at least 185 surveys to obtain an accurate representation of one percent of the total Dalhousie student population (Dalhousie University, 2016). Yet we did not set a limit on how many we were going to collect in order to achieve better accuracy. With the addition of the online surveys, our group collected a grand total of 305.

Originally, each of our survey distribution locations were chosen based on being in close proximity to a food(s) service. However, after some consideration, we believed it would be beneficial to distribute surveys at more varied locations where we could reach a broader group of students. These locations were also chosen based on factors that included but not limited to, being near a bus stop, a bike rack, a crosswalk, a food service, a Dalhousie student parking lot, etc. Utilizing locations close to these amenities was thought to provide a high probability of obtaining a diverse group of participants that take different methods of transportation to school. Our surveys were be distributed around 11:25 am in order to give a range of students in different disciplines the opportunity to complete the survey since this time period is during a class change for numerous subjects and also when students who have an 11:35 am class will be arriving. As a result of these location choices we included a large range in student demographics, thus providing the most accurate results of at least one percent of the Dalhousie student population (Dalhousie University, 2016). A draft of the survey can be found at the end of this report in Appendix D.

By using a survey as our research method, our group was able to determine Dalhousie students' opinions and sentiments towards biking and the possible development of a BSS on Halifax campuses. By asking questions such as "What is your main form of transportation used to, from, and between Dalhousie Campuses?" or "Would you be willing to spend $25 per semester on unlimited use of a potential Dalhousie bike-share system?" helped us gauge if students would take advantage of this additional service or if the implementation would not be of useful to them. For example, we assumed that students who live in the North End of Halifax might find a BBS beneficial, students who live directly on campus or relatively close to campus might be more included to simply walk everywhere. Following the completion of the surveys, a t-test was used to compare the distance that students lived from campus in relation to their desire to implement a third generation bike-share system. Four separate t-test were conducted, the first was for the Sexton campus survey group, the second for the Studley campus survey group, the third for the Carleton campus survey group and the fourth was for the online survey group. The t-test will allow us to quantitatively analyze how a student's distance from the campus may shape

opinions on the desire to implement the system. For our t-test comparison, we will be using a P-value/alpha value of 0.05 to determine the significance between our survey options.

Another statistical analysis method that will be used upon the completion of our survey is a Chi-Square test. The Chi-Square test will help us determine if the observed counts for our data are different enough for the association to be significant. An assumption made for our Chi-Square test analysis is if the expected count for cells containing a value less than five is greater than 20%, then the assumption is violated. Our Chi-Square test will be looking at the association between faculty and desire of implementation of the third generation bike-share system. Therefore, our null hypothesis for this test will be there is no significant association between faculty and desire of implementation of the third generation bike-share system. The alternative hypothesis will be there is a significant association between faculty and desire of implementation of the third generation bike-share system. The Chi-Square test will allow us to quantitatively analyze how a student's faculty may impact opinions on the implementation of a bike sharing system.

Similar to qualitative research, reliability and validity are important for any quantitative analyses (Creswell, 2014, p. 37). With valid and reliable quantitative data, we can gather a more meaningful interpretation of our research (Creswell, 2014, p. 200). Palys and Atchison (2014) define validity as "whether research measures what the researcher thinks is being measured" (p. 434). In order to ensure our data was valid, we measured convergent validity. Meaning that in our analysis, we display that our primary measure (whether or not students would be in favour of a third-generation BSS on Dalhousie Campuses) is related to other indicators, such as distance from campus, main method of transportation to, from and between campuses, and faculty. It is assumed that the measure of those in favor of the program would be those who are environmentally conscious (e.g. students in environmentally related programs), students who do not live exceedingly far or exceedingly close to campus, as well as students who do not already use biking as their primary method of transportation. Seeing as our primary measure is representative of other indicators, it can be concluded that our data has validity. As for reliability, it generally means consistency with scores (Palys & Atchison, 2014, p. 55). Palys and Atchison (2014) recommend a test-retest which shows score consistency over two test periods, in other words, it means that the results are repeated. Due to limitations on time and manpower, completing a test-retest was not able to be carried out. Knowing this, in order to achieve accuracy, we continued to gather surveys even after we achieved our goal of 185. A larger sample size means increased accuracy or as Creswell (2014) explains it, a "large N [sample size] is needed in order to conduct meaningful statistical tests" (p. 269). In the end, we were able to gather 305 surveys.

Despite this, there were some constraints to our research. To begin, we will address the limitations of which we had no control over. The project had a specific timeline. In a group of 6, we each have only so much time to gather and collect information before we had to call it quits and start analyzing data. In addition, as this was not a funded research project, money was not easily disposable. For example, Survey Monkey, has a limit on how many responses can been seen before it cuts off and asks you to pay and upgrade to the full version. Our group was limited by the scope of the project as well as the tools that were accessible to us.

In considerations of delimitations (limitations deliberately imposed by us), there may be errors in the data presented based on our survey distribution methods. As previously stated, our surveys were distributed both online and in person. The online surveys were shared via social media such as Facebook and Twitter. Therefore, they were accessible to any persons whom came across the request to take the survey. Meaning that the survey could be accessed by people who are not a Dalhousie University student and therefore lied about their affiliation. This possibility could have made the data biased. This problem could be fixed by changing the survey structure so that students must first type in their B00 code first in order to take the survey. However, this would make the survey not anonymous.

5. Results

The data analysis for our research proposal was conducted by examining the overall trends and significance of the collected survey data. The 305 completed surveys displayed that 47.5% of participants recognized that the reason for lack of use of the bike center on campus was correlated with the issue that students were unaware that it existed (Appendix A, Figure 1). The data collected confirms our predicted hypothesis that Dalhousie students would use a third generation bike-share system if it were to be implemented on campus. The analysis of the data has demonstrated that 42% of the survey participants said that they would use a third generation bike-share system and 32% of the survey participants said they were indifferent to the implementation of the program. (Appendix B, Figure 2).

To further analyze the data a chi-square test was used to determine if there was a correlation between faculty type and opinion on implementation of a third generation bike-share system. The null hypothesis states that there is no significant association between faculty type and desire to implement the bike-share system. The alternative hypothesis states that there is a significant association between faculty type and desire to implement the bike-share system. The Pearson Chi-Square value was 12.642 with 12 degrees of freedom and an asymptotic significance/p-value of 0.396 (Appendix C, Table 1). Seeing that p-value is greater than the alpha significance value of 0.05. The difference is not statistically significant and therefore we fail to reject the null hypothesis.

The analysis for the data of the Sexton campus, shows a large decrease for desire of implementation between option 1 (0-4km) and option 2 (4-6+km). The t-test was utilized to show significance between the approximate living distance from campus (km) and desire to implement the third generation bike-share system. The null hypothesis states that the Sexton survey group will display no difference in desire to implement the bike-share system between options 1 and 2. The trend can be seen in the statistical analysis since the difference between option 1 and 2 is statistically significant, therefore rejecting the null hypothesis and accepting the alternative that the Sexton survey group will display a difference in desire to implement the bike-share system between options 1 and 2 (t_2= 3.10811476, $0.05<p<0.025$).

The interpretation for the data of the Studley campus, shows a large decrease for desire of implementation between option 1 (0-4km) and option 2 (4-6+km). The t-test was utilized to show significance between the approximate living distance from campus (km) and desire to implement the third generation BSS. The null hypothesis states that the Studley campus survey

group will display no difference in desire to implement the bike-share system between options 1 and 2. The trend can be seen in the statistical analysis since the difference between option 1 and 2 is not statistically significant, therefore we fail to reject the null hypothesis. (t_2= 1.86052102, 0.15>p>0.10).

The data analysis for the Carleton campus, shows a large decrease for desire of implementation between option 1 (0-4km) and option 2 (4-6+km). The t-test was utilized to show significance between the approximate living distance from campus (km) and desire to implement the third generation bike-share system. The null hypothesis states that the Carleton campus survey group will display no difference in desire to implement the bike-share system between options 1 and 2. The difference between the two options is not statistically significant, therefore we fail to reject the null hypothesis. (t_2= 2.36351579, 0.10>p>0.05).

The interpretation for the online survey, shows a large decrease for desire of implementation between option 1 (0-4km) and option 2 (4-6+km). The t-test was utilized to show significance between the approximate living distance from campus (km) and desire to implement the third generation bike-share system. The null hypothesis states that the online survey group will display no difference in desire to implement the bike-share system between options 1 and 2. This overall trend can be proven since the difference between the two options is not statistically significant, therefore we fail to reject the null hypothesis. (t_2= 1.36544083, 0.20>p>0.15).

6. Discussion

As previously mentioned, our research was catered around answering the main question: 'If a third generation bike-share system (BSS) were to be implemented on Dalhousie's Halifax campuses, would students utilize the program and be in favor of funding it?' In order to answer this question, we had to first find out the current opinions of the students at Dalhousie regarding the existing system, and any particular reservations in regards to it. While there were varying reasons to Dalhousie students' lack of use of the existing bike services, we were able to determine the most common reasons being, inconvenient location / hours, high cost, and in majority the lack of knowledge of the presence of the bike center. However, when asked the question if the students would use the bike share system if one was to be implemented, majority of the respondents either agreed to pay the fees, or were indifferent to it. In the case where students responded as indifferent to the system, it is expected that the students could be persuaded in the future once a system is in place and its effectiveness and availability can be evidently be seen by the students. Our findings allowed us to better understand student opinions and needs in relation to a bike system, and also allowed us to determine the feasibility of implementing a third generation BSS at Dalhousie.

Inconvenient location / hours, the top reason chosen by most student as a hindrance to their use of the current BSS, the solution for it lies within the accessibility features of a third generation bike-share system. In a study conducted at Kent State University, it was found that one of the main reasons for which students would be less willing to use an available bike system would be in regards to impediments such as weather, infrastructure design, traffic, perceived safety, and the requirement of helmets (Kaplan & Knowles, 2015). The reoccurring theme within our case study of Kent State University, and here at Dalhousie are the limitations of the current

infrastructure. Many of the limitations in the current system are in coherence with student opinions in regards to the accessibility of the bike stations. One of the concerns with perceiving the results was in regards to the commute distance, given that part of the students at Dalhousie take more than a 4 km commute regularly, which can be a factor of deterrence to using the bike rental facilities, this can be seen in our results where there was significance observed in the willingness to use the system and the commute distance. In the case of a third generation BSS the automated docking system allows for twenty-four-seven renting hours, without limiting student access to certain hours of the day or to certain locations, therefore further encouraging use, and also giving students with longer commutes the opportunity to travel within the three campuses and/or for one leg of their journey coupled with other sustainable transportation methods such as the transit system, or carpool (Kaplan & Knowles, 2015).

Lack of knowledge of the bike center was the response selected by almost half the respondents, a consideration from this response was given towards the structuring of curriculums in courses offered at Dalhousie, in particular whether courses offered at Dalhousie across varying faculties presented a varying importance given to the aspect of sustainability on campus. It was expected that faculties more centered on themes of sustainability would produce respondents with a higher willingness to utilize the bike system, however this was not the case seen from our results, which concluded no significant association between student responses and their faculty. However, despite this it is still important to consider the importance given to sustainability in academia as this influences students' awareness and willingness towards such a system.

The varying responses between the students within the three campuses could be explained with the campuses' proximity to other amenities such as transit lines, the current bike centre, and the major downtown areas of Halifax. One of the expectations of a third generation BSS, is not a restricted use between campus and residence, but to also give students the ability to commute within campuses, and to and from other locations of the city, where the docking stations could be set up. This could be in accordance to the close proximity of Sexton campus with the downtown area and students' willingness to use the bike-share system to commute to other locations, and an expectation of a new system to meet all their demands as many of these respondents were unaware of the current system. In the case of the Studley campus, this campus has the closest proximity to the Dal bike center, indicating that these students were most likely to be the ones aware of the current services and would be less keen on utilizing a new system and dismayed given the lack of facilities of the current one. With the case of Carleton campus where there is a larger number of students from graduate faculties, which were not represented through our surveying, it is expected that from our methods we were not able to gain the best representation for the students at that campus.

This survey results are in lieu with the recent results of the Dalhousie Student Union elections, where the Dal Bike Centre fought to be able to allow students the opportunity to vote for the implementation of a levy for the Dal Bike Society, with the intention to dedicate funds specifically towards the expansion of the bike center. This can be seen as another indicator of student opinion weighing towards the availability of more sustainable methods of transportation on Dalhousie campuses, which coincides with our study's broader approach of considering the feasibility of the introduction of a sustainable transport method such as a third generation bike-share-system at Dalhousie University.

7. Conclusion

Our research indicates that Dalhousie University students are overwhelmingly unaware of the current biking infrastructure and services provided on campus. Despite this, students' present keen interest in the prospects of a third generation BSS that would provide affordable, convenient, and environmentally friendly active transportation on and around Dalhousie's Halifax campuses. Students indicate a willingness to pay for a third generation BSS, and would utilize one if it were to be implemented. The biggest constraint students expressed in a prospective system was hours of operation and convenience of locations. These limitations do not exist in the third generation BSS model.

We recommend that the present biking infrastructure at Dalhousie University is expanded and promoted. Our findings present a concerning revelation regarding the lack of acknowledgement towards the Dal Bike Centre among students. This could be solved via publicity projects such as posters, social media, fundraisers, sponsorships/campaigns, Dalhousie orientation week activities, etc. As for further research regarding a BSS being implemented on Dalhousie's Halifax campuses, we recommend that organizations such as Switch Hfx, Cyclesmith, I Heart Bikes, Halifax Bike Week, and Halifax Cycling Coalition are contacted and asked to be involved in order to broaden the scope of our research. We are hopeful that a third generation system will be successful and eventually implemented on Dalhousie's Halifax campuses.

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9. Appendices

9.1 Appendix A

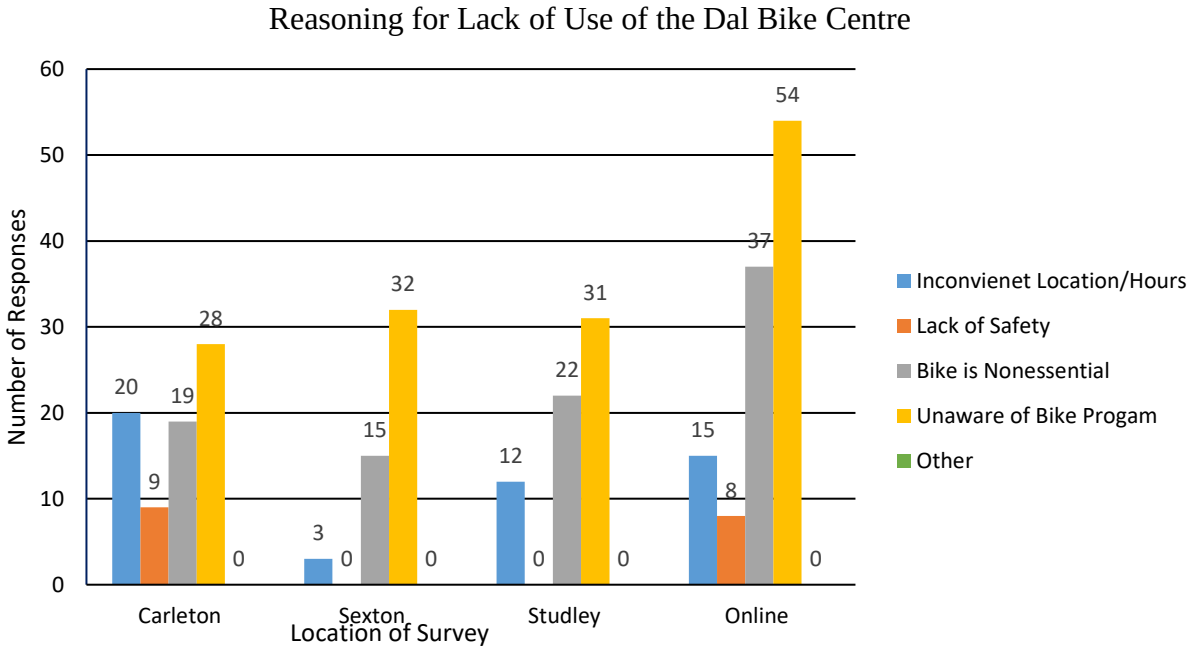

Figure 1. Reasoning for students not using the Dal Bike Centre. Data collected by Ferguson, Frazer, Gerlofs, Nasir, Shipway, & Walker, Dalhousie 2017.

9.2 Appendix B

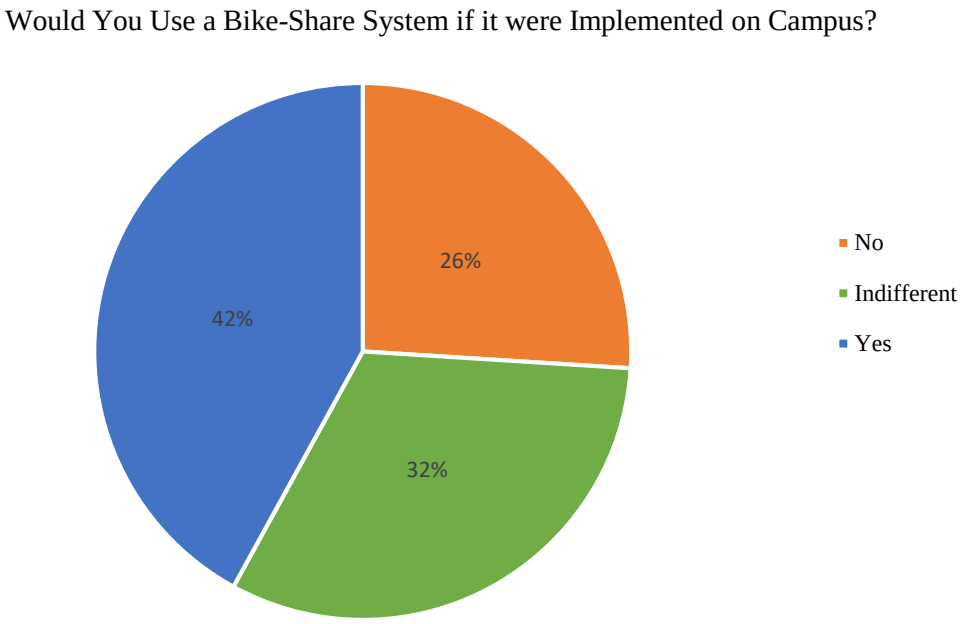

Figure 2. Student's willingness to use a BSS. Data collected by Ferguson, Frazer, Gerlofs, Nasir, Shipway, & Walker, Dalhousie 2017.

9.3 Appendix C

Table 1. Chi-square components, data collected by Ferguson, Frazer, Gerlofs, Nasir, Shipway, & Walker, Dalhousie 2017.

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.642[a]	12	.396
Likelihood Ratio	12.902	12	.376
N of Valid Cases	305		

9.3 Appendix D

Dalhousie Bike-Share System Questionnaire

1. What is your main form of transportation used to, from, and between Dalhousie Campuses?
□ Car / motorized vehicle □ Public Transit □ Public Transit
□ Walk □ Other, please specify: _____

2. Have you ever rented a bike from the Dal Bike Centre?
□ Yes, frequently □ Yes, sometimes □ No, never

3. What is the main reason you have not rented from the Dal Bike Centre?
□ Inconvenient hours/location □ I do not feel safe biking in Halifax
□ I do not need/want to bike □ I did not know Dalhousie had a bike centre
□ Other, please specify: _____

4. Would you use a bike-share system if it were implemented on campus?
□ Yes □ No □ It depends..

5. What would be your biggest reason as to not utilize a bike-share system?
□ High cost □ Lack of safety □ I don't need/want to bike
□ Inconvenient locations of bike rental stations
□ Other, please specify: _____

6. If a fee to use the system were included in your tuition would you bike more?
□ Yes □ No □ It depends..

7. Would you be willing to spend $25 per semester on unlimited use of a potential Dalhousie bike-share system?
□ Yes □ No

8. How far approximately (in km) do you live from campus?
□ 0-2km □ 2-4km □4-6km □6+km

Dalhousie Bike-Share System Questionnaire

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Figure 3. Survey, created by Ferguson, Frazer, Gerlofs, Nasir, Shipway, & Walker, Dalhousie 2017.

9.3 Appendix E

Consent Form

Serial No. XXX

As part of the term project for ENVS 3502, we are looking at different possible aspects in which we can make our campus more sustainable. This project looks at the prospect of expanding the Dal Bike Centre making it more accessible to all Dalhousie students irrespective of which campus they spend majority of their time on. For the preliminary research for the project, we are conducting a survey, with the help of this survey we are hoping to understand the current mind-set of students in regards to the bike project, and their opinion on a prospective expansion.

This survey requires the participants to include some information, in particular information about their commute. Any information given by the participant will only be used for the purpose of this research and will not be released to any other personnel other than the interviewee.

I give consent for the information I provide to be used for the purpose of this project, and am aware of the details regarding the project.

Signature

In a situation where you wish to withdraw your response from the research, please email us on tb664803@dal.ca, with your consent form serial number as the subject of your email. All withdrawals need to be received prior to April 1st, 2017.

Figure 4. Consent form, created by Ferguson, Frazer, Gerlofs, Nasir, Shipway, & Walker, Dalhousie 2017.

10. Acknowledgements

Thank you to our instructor C. Greene, our mentor Navya Pandit, and our wonderful survey respondents.