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Abstract

With a focus on smart mobility and the sharing economy, car sharing is a distinctive transportation choice within the context of sustainable development. It provides a flexible mode of transport for its users and has been proven to reduce personal CO2 emission, vehicle miles traveled (VMT) and reduction in car ownership. While UniverCity's has put in place car sharing since 2005, surveys by Mustel Market Research indicate car share usage remains low at less than five percent.

Overall this project is not intended to comprehensively chronicle UniverCity's car sharing activity; rather it tries to use residence feedback and desktop research to identify the potential barriers of car share usage in UniverCity. The survey reflects residences to have strong interest and support in car sharing in order to reduce transport cost as well as to forgo the need of a second vehicle. That being said, they are held back in using car sharing due to uncertainty of cost, unawareness of car sharing operations and its poor accessibility.

Introduction

Car Sharing is growing in popularity and has become a familiar alternative mode of transport in urban developments. It provides the freedom of travel much like a personal vehicle but without the financial responsibilities of car ownership. Car sharing operates through a sharing and booking system by utilizing technologies such as global positioning systems (GPS), cloud computing and smartphone devices. Vehicles are located within a geographic boundary or stationed in common destinations such as skytrain stations, shopping malls and community centers. Over the years organizations have enhanced car sharing services by providing various sizes of vehicles (e.g. minivans or trucks) as well as sport rack attachments.

Various car sharing reports refer to Britton's diagram (Figure 1) to identify car sharing as the 'missing link'[1] in the current available mode of transport (public transit, taxi, cycling). That being said, car sharing should not be viewed as a standalone mode of transport, rather it is an intrinsic element of achieving an overall sustainable transportation network. As Castle (2015) puts it, car sharing is about "encouraging members to drive less often, plan trips more, use other modes of transportation more, and share fuel efficient vehicles when a car is needed".

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[1] Britton, E (1999), "car sharing 2000: Sustainable Transport's Missing Link", p.2
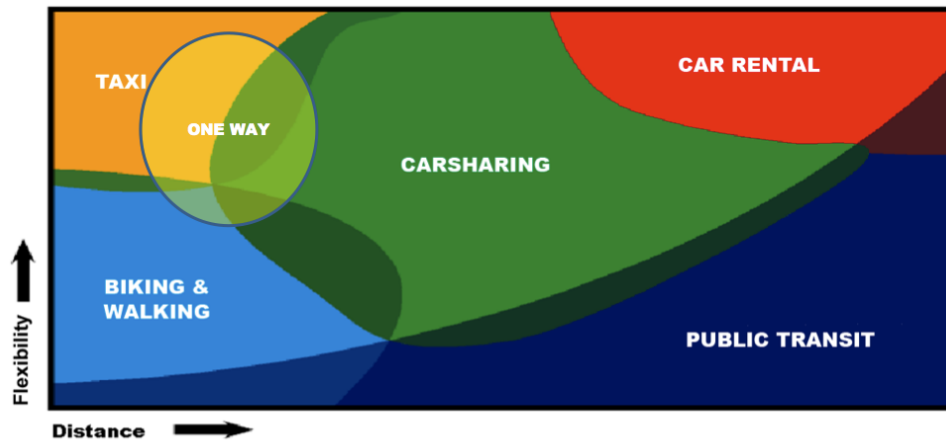
(Figure. 1) Britton's diagram on how car share fits with other near-by modes in the new transport configuration

Two predominant methods of car sharing are described below:

Station Based or "Return" Car Sharing services

As the name implies, vehicles in station based car share services have designated parking spots strategically placed throughout the city. In the Lower Mainland, Zipcar and Modo are based on this platform.
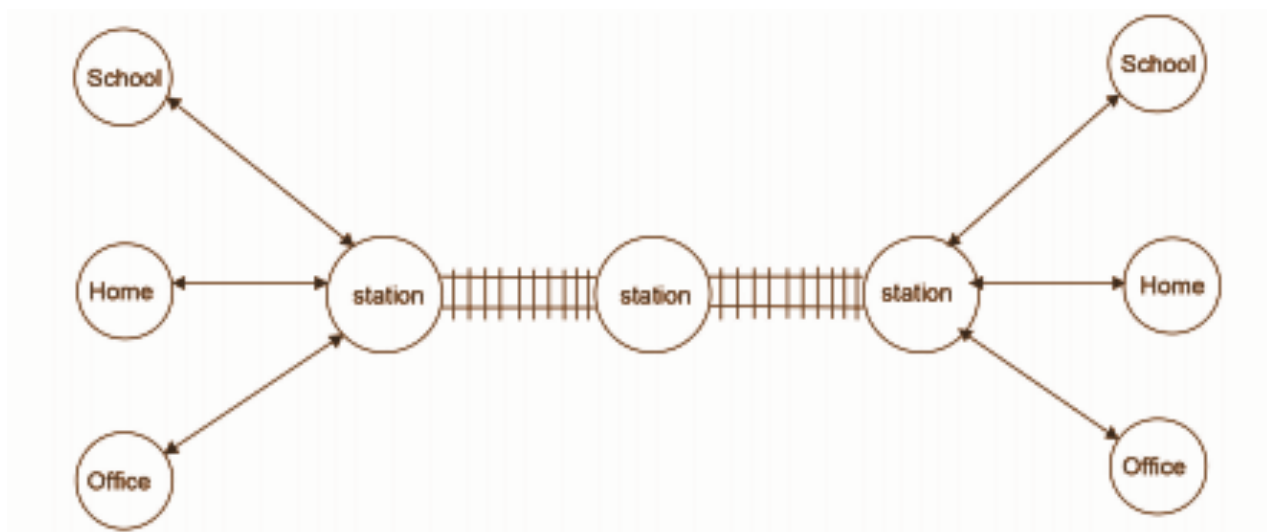
Model of a Station Based Car Sharing (Source: Adapted from Barth and Shaheen 2002)

Operationally, members are required to reserve (online, by phone or via mobile app) a vehicle hourly or by the day. This timetable system ensures no conflict between other members who may wish to use the same car. Members return the vehicle to the same designated spots at the end of use and failure to do so will incur extra fees.

"Free-Floating" car sharing Services

This car sharing services allows more flexibility and spontaneity as members can finish their journey and park at any location based on a set geographical boundary (known as 'home zone' by Evo).[2] With the utilization of smart phones, users on Apple iOS or Android devices can use the car share company's app to locate and book their preferred vehicle (Figure. 1). For instance, a member can take use of the car at UniverCity to drive down to Gastown for a night out and if the driver is unable to drive home, he or she can leave the car in Gastown. While users have more flexibility in locating and finishing their service, there is no guarantee for the user to find the vehicle at the same spot as another user may relocate it.

Two car sharing companies based on this model of service are Car2Go and Evo. As of 2016, Car2Go does not have parking boundaries at Simon Fraser University (SFU) or at UniverCity.

Model of a Free-Floating car sharing
Source: Adapted from Barth and Shaheen (2002)

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[2] Map of Evo 'home zone' https://evo.ca/-/media/evo/images/news/Map_HomeZone_May16_PSS_v3_final.ashx
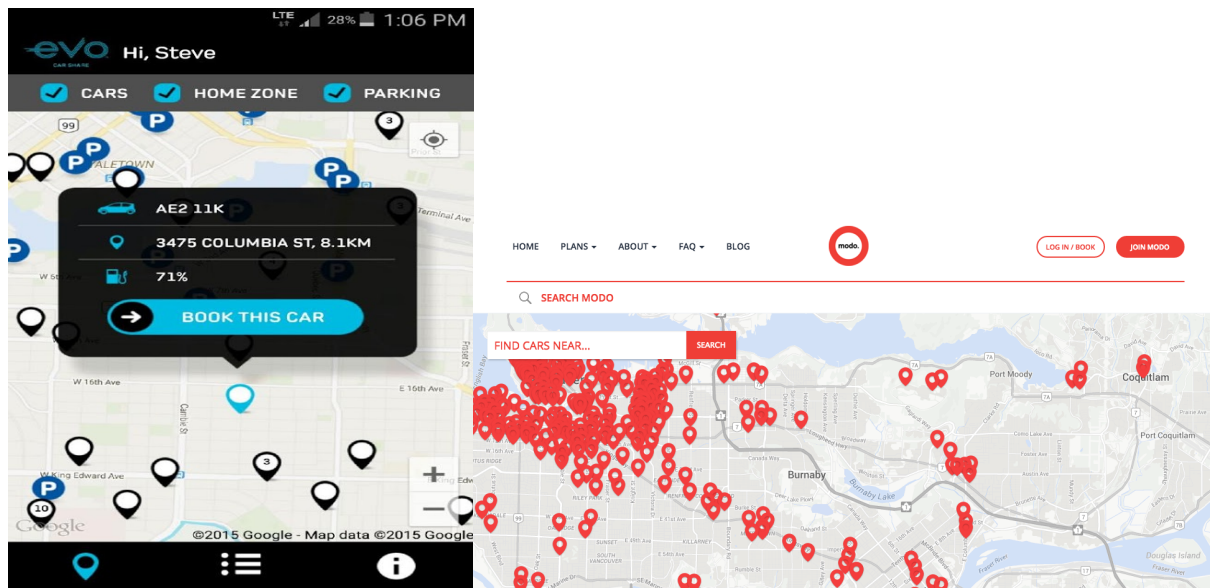
(Figure. 1) Screenshots of car share mobile and website applications, Evo Left, Modo on the Right

Car Sharing Advantages

Environmental Improvements

Many car sharing vehicles take use of hybrid engine vehicles or low emission gasoline engines in their fleets. Compared to privately owned vehicles, car sharing vehicles are newer on average. For example, Modo identifies most of their vehicles to be 2013 or newer.[3]

In a 2013 report by the California Environmental Protection Agency (2013) calculated car sharing had created an average of 26.9% reduction in average vehicle miles travelled. Effectively, this meant a reduction in greenhouse gases, fuel usage as well as increased usage of public transportation and cycling. Zipcar estimates that each car share vehicle reduces personal CO_2 emissions by between 1,100 and 1,600 pounds per year.[4]

Financial benefits

The cost of owning a personal vehicle according to the Canadian Automotive Association (CAA) is about ten thousand dollars (Figure 2). Personal vehicle expenses are high and unpredictable due to cost of vehicle maintenance (oil change, tire replacement, etc.) and fluctuating insurance and fuel prices. With car sharing, members do not have to worry about the aforementioned costs as it is accounted for by the organization.

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[3] http://modo.coop/ourfleet/
[4] Shaheen & Martin (2010), "Greenhouse Gas Emission Impacts of Car Sharing in North America"

In addition to cost of vehicle operation, storage of private vehicles is also a financial burden for both homeowners and developers. Homeowners with more than one personal vehicle in multi-family unit developments may face parking rental fees. For developers, the ability to substitute car sharing spaces for reduced parking stalls in underground lots can mean a savings of up to $40,000 per stall.[5] Noteworthy, the City of Burnaby currently does have any provisions of reduction of parking stalls through the integration of car share spaces. However an example of the City of Vancouver provision states:

> "In multi-unit buildings, parking can be substituted at a 1:5 ratio to a maximum of one shared vehicle and one shared parking space for each 50 dwelling units, or a higher maximum as deemed appropriate by the Director of Planning and General Manager of Engineering Services." (Metro Vancouver, 2014, p.17)

Provisional measures such as the one above could translate to developer savings, and these savings can be put to use in a transportation demand management plan to provide cost saving measures to encourage higher car share membership and usage.
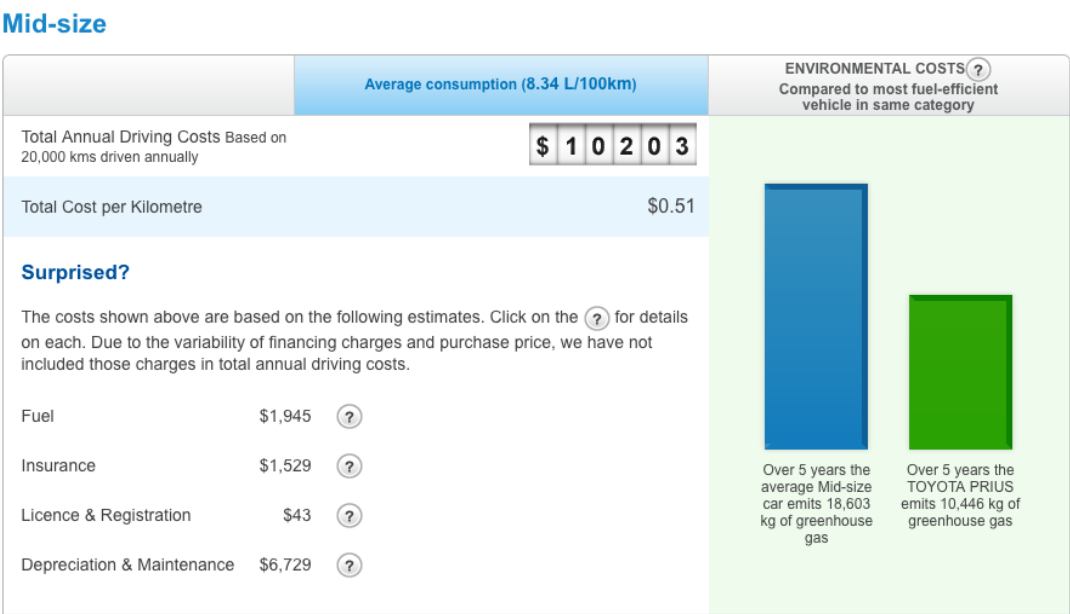
(Figure. 2) CAA 'driving cost calculator: http://www.caa.ca/driving-costs/

Car Sharing at UniverCity

UniverCity began its car sharing services in 2005 with Modo. Next to follow was Zipcar in 2008, then most recently with Evo which established its satellite parking stalls located at the south parking lot of the Hub. Expansion of car sharing vehicles is expected as the Centreblock development, with

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[5] Perry (2016), http://www.bcbusiness.ca/retail/vancouver-developers-eye-benefits-of-car-sharing

11 sheltered parking spaces dedicated to car share vehicles. Diagram 1 highlights the current allocation and type of vehicles available within the UniverCity boundary. It should be noted that Zipcar and Modo vehicles have additional car sharing pods on the western wing at SFU Burnaby Campus.

That being said, diagram 2 illustrates that current car share vehicles are outside of the 200 metre walking radius from a number of UniverCity buildings. For instance, residences of One University Crescent (OUC) will have to walk 600 metres, unsheltered, in order to access the nearest vehicle. As the survey revealed, the distance from accessing car sharing is an important factor in switching over to car share.

Research and Methods

While car sharing has been established for UniverCity residences since 2005, the actual usage remains below 5% annually.[6] The research seeks to identify the causation of the low usage rate, and whether expanding car sharing members and vehicles is feasible in UniverCity's sustainable transportation plan.

A qualitative survey was sent out to UniverCity residences over a 10-day period from July 12th to July 22nd 2016. Due to the time constraint and limited resource, surveys were sent out by e-mail only to residences registered in UniverCity's e-mailing list. A poster informing of the survey was also posted at the bulletin wall outside of the Cornerstone Building (Figure 4). The survey was created with Google Form and participants were instructed to fill out the form directly on the webpage. An incentive was provided, with one recipient of the survey being randomly drawn for a $100 Nesters Market gift card.
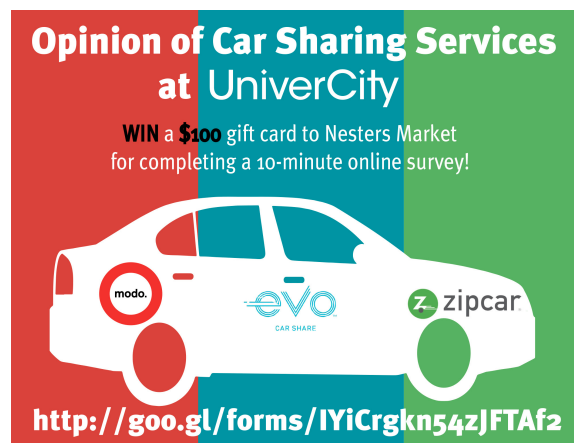
(Figure 4) Advertisement poster sent to UniverCity residences

In the ten-day survey period, 104 completed surveys were received. Based on a community population of 9000 members, this represented a confidence interval of +/- 9.55% at a 95% confidence level. The survey was designed to gather information and feedback of resident's

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[6] http://univercity.ca/media/research/

perception of car sharing at UniverCity. The questionnaire was in three parts. The first part contained general questions to understand the demographic of the survey sample in order to see if there is any major deviation when compared to the Mustel Research Survey completed in 2014. The second part is focused on questions with car sharing, specifically on travel behaviour, access and cost. The last part asked the respondents on their level of connectivity with social media and mobile applications to seek whether they were connected with UniverCity's car sharing network.

Key Findings

Demographics

The demographic of the sample survey highlights strong potential for increasing the market penetration rate for car sharing. Household makeup with more than one family member accounted for 80.2% of the sample. 68.9% own one vehicle while ownership of two vehicles is low, as 12.6%.

In Metro Vancouver's car sharing Report (Table 1), it highlights that households with 1 or 2 cars have greater potential (26% and 36% elasticity, respectively) in shifting towards lower car ownership.
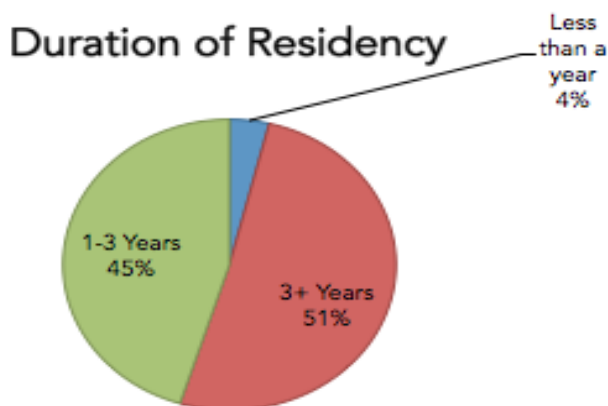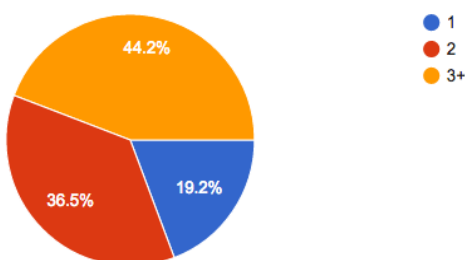
| After Joining Car Share / Before Joining Car Share	Zero Vehicle Household	1-Vehicle Household	2-Vehicle Household	3 Plus Vehicle Household	Total
Zero Vehicle Household	984	80	1	1	1,066 (38%)
1-Vehicle Household	323	905	15	0	1,243 (45%)
2-Vehicle Household	18	121	242	6	387 (14%)
3 Plus Vehicle Household	0	2	11	71	84 (3%)
Total	1,325 (48%)	1,108 (40%)	269 (10%)	78 (3%)	2,780

Table 1. Comparison of Household Vehicle Holdings Before and After Joining Car Share n=2870 (Metro Vancouver, 2013)

75% of the respondents currently own their home. Residences from Harmony and Serenity accounted for the most responses in this survey.
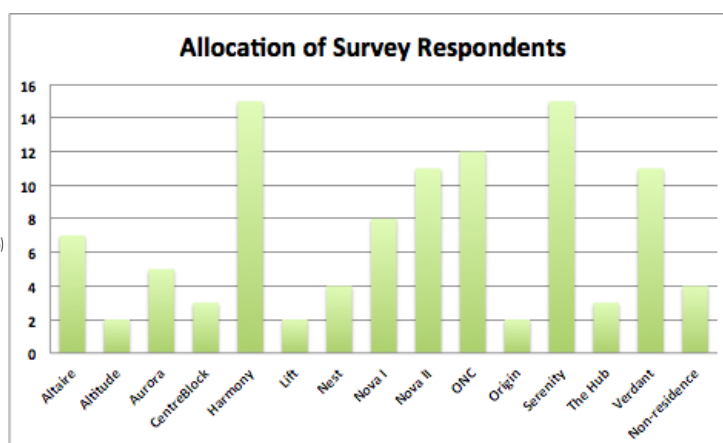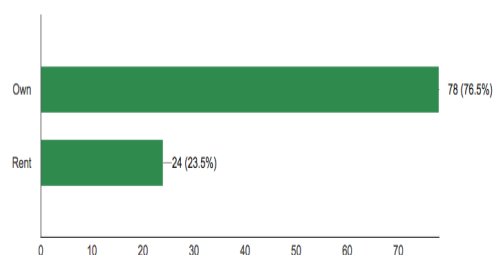

Almost all (98%) of the survey members have a valid driver's license with more than three years of driving experience. Noted, car sharing company, Evo, requires at least 3 years of driving experience. Zipcar and Modo requires at least 1 year of driving experience.

Vehicle Ownership

68.9% currently own one car, with 12.6% having two vehicles per household. 18% of the residences do no own personal vehicle.

How many cars do you currently own or lease? (103 responses)


Legend:
- None
- 1
- 2
- 3+

68.9%
12.6%
17.5%
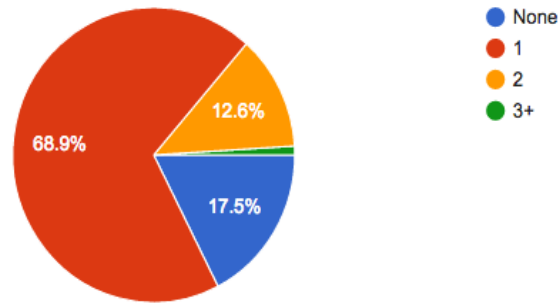
The majority of vehicle types owned by the survey group were gasoline-engine based at 72.8% While only 7.8% owned a hybrid vehicle. 18.1% do not have a vehicle.

Vehicle Engine Types

Categories: Diesel Engine, Gasoline, Hybrid, No Vehicle
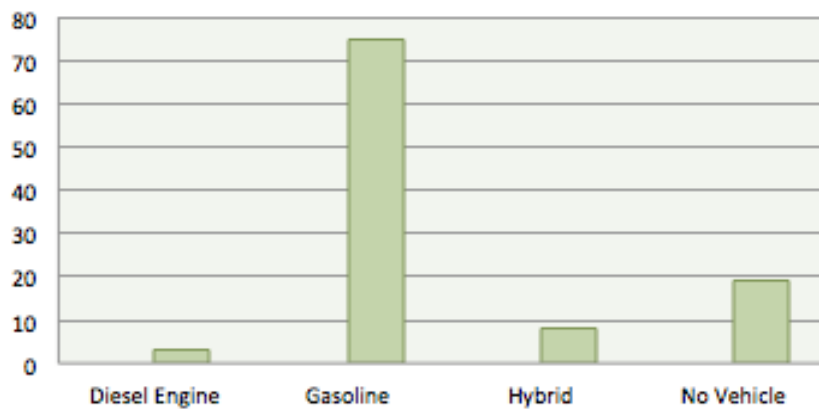
Over half of the residences do not utilize off-street parking at UniverCity. On the other hand, 10 of the 104 (9.6%) respondents take use of the off-street parking daily. In a site visit, on-street parking at UniverCity remain at near full capacity during off work hours.

Do you currently take use of the on-street parking around UniverCity? (104 responses)

Legend:
- Yes, Daily
- Yes, Occasionally
- No

56.7%
9.6%
33.7%
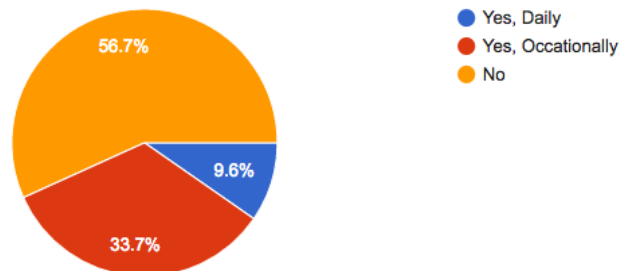
Travel Behaviour

Personal vehicle or public transit account for half of the primary mode of transportation to work. 29.4% responded with walking as their primary way to get to work. This is a similar trend compared to the 2014 Mustel Group survey.

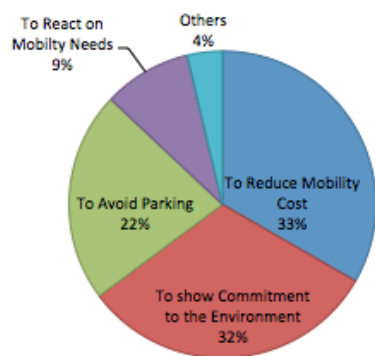### How to you primarily get to work on a daily bases?
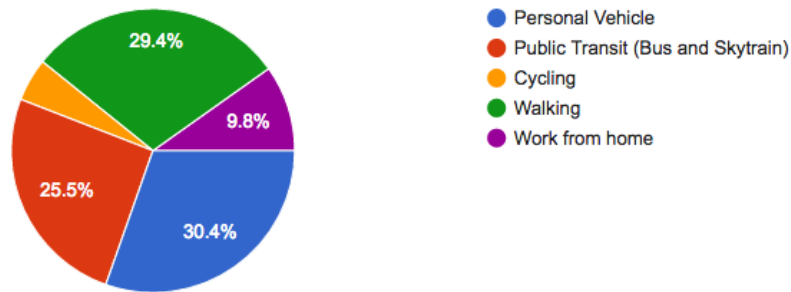
Personal vehicle becomes more prevalent (74.5%) with off-work related activities such as going to the gym, grocery shopping and dining out. Only 19.6% of the respondents identify the use of public transit as a mode of transportation for off-work activities.

What is your primary transportation method for off-work hour activities? (e.g. going to the gym, heading out for dinner, etc...)
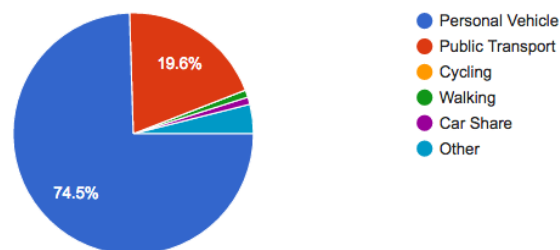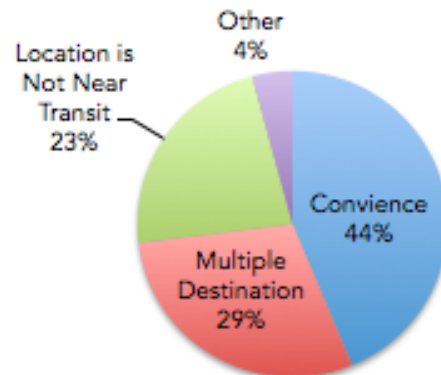

Residences who take use of alternative transport identify reduce cost, improving the environment and avoiding the need to find parking spaces to be a factor in their modal decision. On the other hand, those who choose to take use of personal vehicles to off-work destinations mainly identify convenience as the primary reason.

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Reasoning to Use Alternative Modes of Transport

Reasoning for Using Personal Vehicle

- To React on Mobilty Needs 9%
- Others 4%
- To Avoid Parking 22%
- To Reduce Mobility Cost 33%
- To show Commitment to the Environment 32%
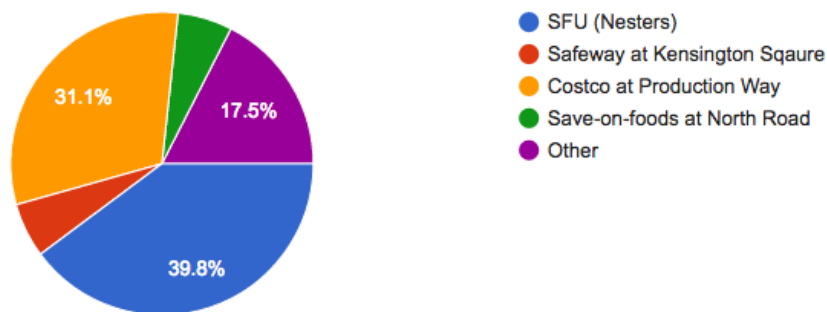
- Other 4%
- Location is Not Near Transit 23%
- Convience 44%
- Multiple Destination 29%

Although residences are within close proximity of the Nesters Market, only 39.8% identify it as their primary location for groceries. About 40.0% of the residences perform their grocery duties at Costco Production Way, Safeway Kensington Square and Save-on-food North Road, which is all within a 5 km radius from UniverCity.

Where do you primarily do your grocery shopping?

- 31.1%
- 17.5%
- 39.8%

- ● SFU (Nesters)
- ● Safeway at Kensington Sqaure
- ● Costco at Production Way
- ● Save-on-foods at North Road
- ● Other

Car Sharing Usage

80.8% of the residences are aware of car sharing as an available mode of transport at UniverCity. However, 27% responded to having a car sharing membership, Out of the three available car sharing organizations at UniverCity, there are marginally more Modo members than Evo and Zipcar. Noteworthy is that a number of residences responded with Car2Go Memberships.

UniverCity
BETTER LIVING ON BURNABY MOUNTAIN

Do you currently have a car sharing membership? (104 responses)
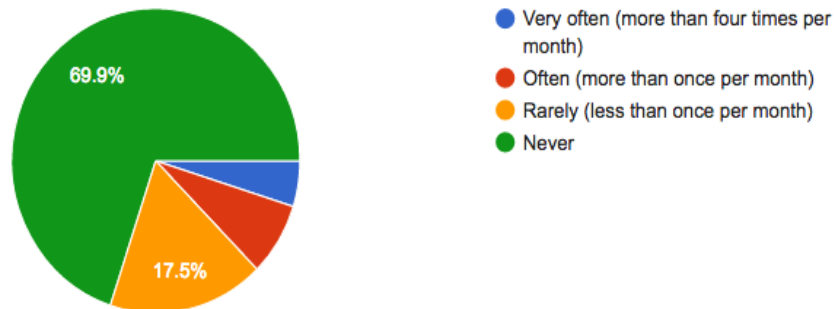

- Yes
- No

73.1%

26.9%
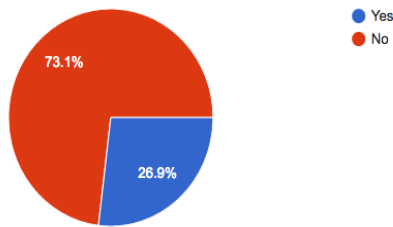
Active Carsharing Memberships
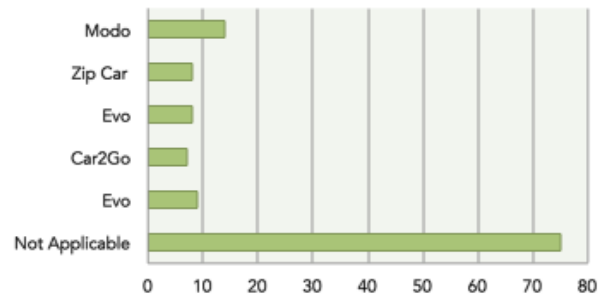
Car sharing usage is low. 69.9% have never used car sharing before, while 17.5% use car sharing vehicles for less than once a month. Only 5% utilize car sharing for more than 4 times a month.

How often do you use the car share vehicle?

69.9%

17.5%

- Very often (more than four times per month)
- Often (more than once per month)
- Rarely (less than once per month)
- Never

Perception of car sharing Cost

Cost is a predominant factor for residences to consider car sharing as an alternative mode of transportation. There is significant agreement that financial savings are important in joining car sharing services.

Do you agree with the following statement: "Financial savings are an important reason for me to join car share"

1 = Strongly Disagree
5 = Strongly Agree

9 (8.8%)
6 (5.9%)
27 (26.5%)
29 (28.4%)
31 (30.4%)
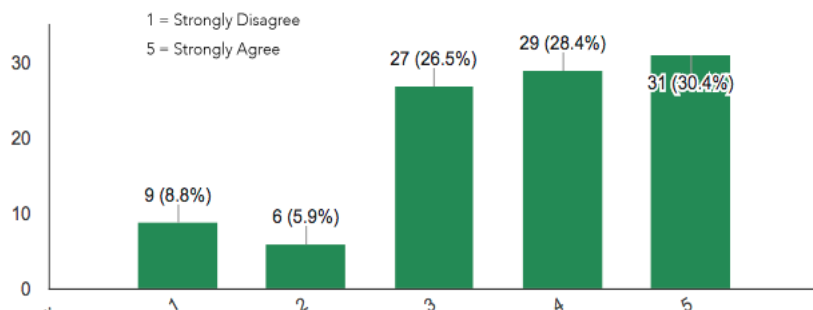
One of the highlights from the survey results was the high level of unawareness in car sharing costs and membership. 46.2% choose the lowest score when asked about their understanding of car sharing costs.

I am aware of the membership and usages costs of all car sharing services at UniverCity

1= Strongly Disagree
5= Strongly Agree

48 (46.2%)
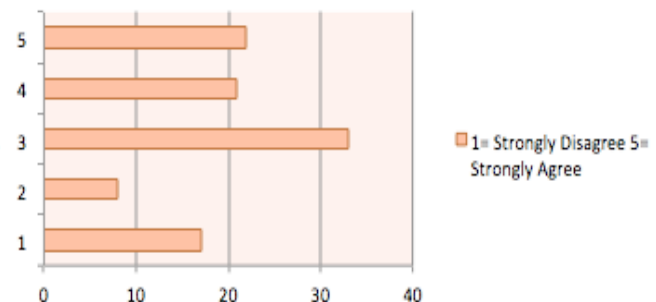20 (19.2%)
13 (12.5%)
13 (12.5%)
10 (9.6%)
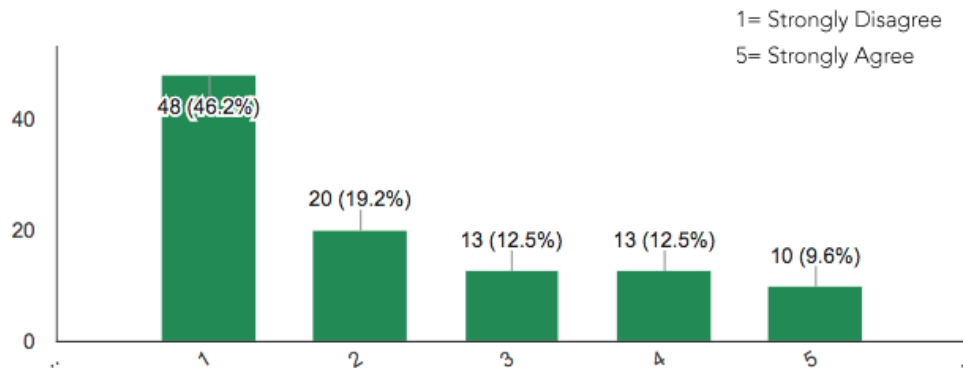
The majority of residences have interest in signing up for a contract-based car sharing account if it can provide lower car sharing cost. Currently Zipcar offers a Business account based membership where members of the group are required to pay a deposit for a reduced hourly fee.

"A web based tool for comparing prices of carsharing with private car will encourage me use carsharing

1= Strongly Disagree
5=Strongly Agree
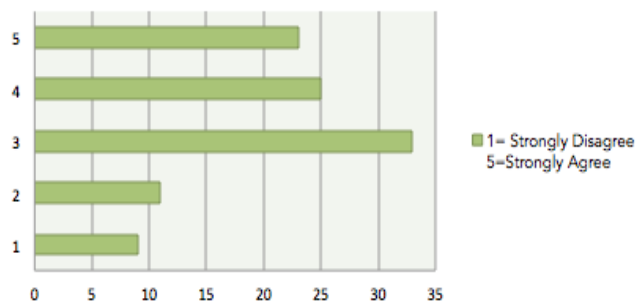
Interest in a contract based carsharing membership if it provides lower car sharing cost

1= Strongly Disagree 5= Strongly Agree

UniverCity
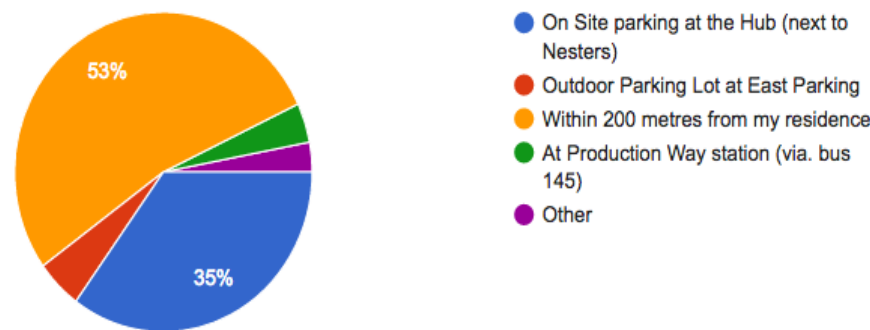BETTER LIVING ON BURNABY MOUNTAIN

Car Sharing Access

Satisfaction is neutral in regards to the distance to access car sharing as well as familiarity of the current car sharing locations at UniverCity.

### The car sharing services at SFU are easily accessible
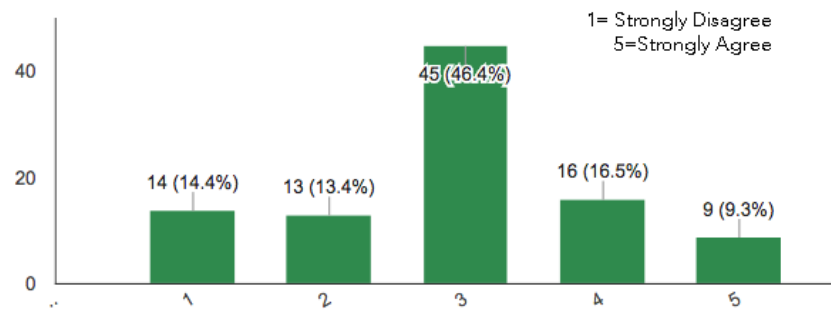
About half of the residence (53%) would prefer to greater access to car sharing within a 200 metre walking distance of their home, while the 2nd prefer choice (35%) is to expand the current car sharing fleet at the eastern parking lot (south of the Cornerstone building).

If more car sharing vehicles were to be allocated, which location would you prefer?

Legend:
- On Site parking at the Hub (next to Nesters)
- Outdoor Parking Lot at East Parking
- Within 200 metres from my residence
- At Production Way station (via. bus 145)
- Other

32.7% would prefer flexible parking options for car sharing instead of designated parking spots at UniverCity. Evo currently does not provide a free-floating parking option at UniverCity, rather, a satellite parking station is based at the outdoor parking lot at the Hub (see Figure 5).

I would prefer to park car sharing vehicles anywhere in UniverCity as opposed to a designated car sharing parking zone.

1= Strongly Disagree
5= Strongly Agree

17 (16.8%)   9 (8.9%)   22 (21.8%)   20 (19.8%)   33 (32.7%)
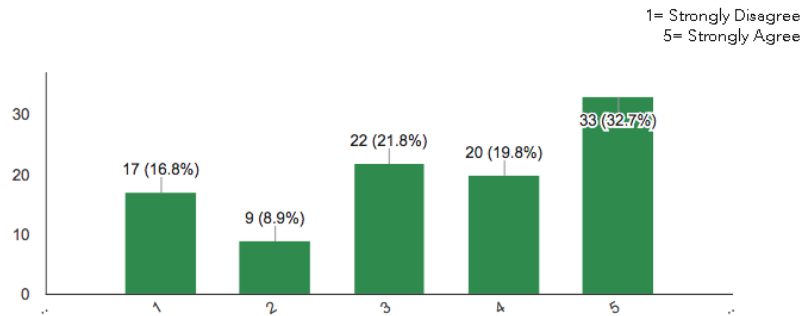
(Figure 5) Designated Evo Parking at the Hub

Connectivity and Awareness

Car share organizations take use of smartphones and computer devices as a means to connect to its vehicles as well as a platform to provide car sharing awareness. Therefore, the final part of the survey was conducted to see whether or not residence in general utilizes social media/smart phone technology.

89.4% of the survey samples currently own a smartphone device. Those with car sharing application (apps) installed on their phone are low (below 15% for each car sharing apps). On the other hand, 33% of the respondents currently take use of the Translink Mobile app, which provides real-time information on transit times and routing.
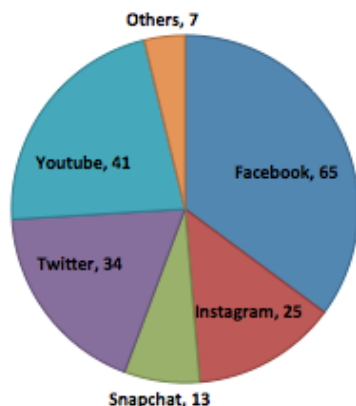
Do you currently own a smartphone with internet access (e.g. iPhone, Android, Blackberry)
(104 responses)

- Yes
- No

89.4%
10.6%

- Car2Go App
- Evo App
- Modo App
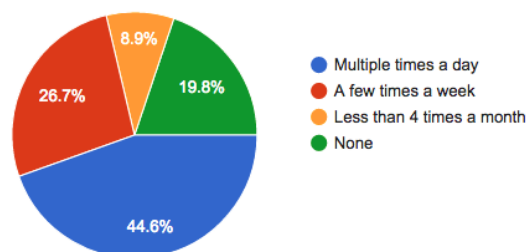- Zipcar App
- Translink Mobile
- Not Applicable
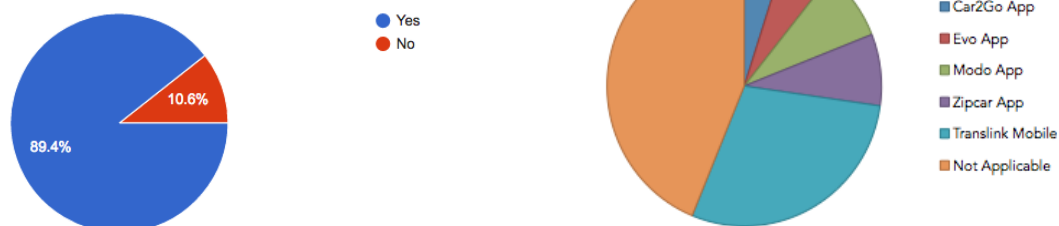
There is high usage and membership rate for social media platforms such as Facebook, Instagram, Youtube and Twitter. 44.6% of users saying they take use of social media multiple times a day.

Usage of Social Media

Others, 7
Youtube, 41
Twitter, 34
Snapchat, 13
Instagram, 25
Facebook, 65

How often do you take use of the social media platform?

- Multiple times a day
- A few times a week
- Less than 4 times a month
- None

8.9%
19.8%
26.7%
44.6%

That being said, 61.8% of the survey respondents do not currently follow UniverCity's social media platforms (Facebook, Instagram, Twitter, monthly newsletter).

Do you follow UniverCity's social media platforms on Facebook, YouTube, Instagram and Twitter as well as the monthly newsletters?

- Yes
- No

61.8%
38.2%

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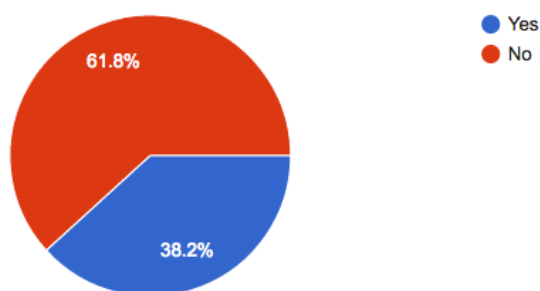
Respondents Comments

At the end of the survey, survey participants were given the opportunity to comment on car sharing, how it appealed or not appealed to them and whether they had additional feedback on car sharing at UniverCity.

In terms of the question for "Why does car sharing appeal to you?" comments focused on the appeal of reduced cost as well as the convenience of an alternative mode of transportation.

When asked for the reasoning behind why car sharing would not be of interest, majority of the comments referred to the lack of vehicle availability and the high operating cost of car sharing.

Below are samples of some comments from survey participants, a full list of the comments can be found in Appendix A:

"Why is car2go not at the mt.(sic)?"

"More cars in more places, too far from the main housing at univercity"

"Please reduce the amount of car sharing and remove spots from all stratas in UniverCity and from in front of Nesters/ Conerstone (sic). These are annoying to people who own vehicles and reduce important guest parking spots"

Recommendations

The survey responses highlight the barriers of car sharing at UniverCity for residences which are, uncertainty of service and cost, as well as poor accessibility.

Promotion of car sharing

Most residences favor car sharing as they believe it can help reduce their cost of transport, yet, the majority of them actually do not know the details of car share costs. To provide more awareness, UniverCity can implement more outreach projects to enhance residence's knowledge of the car sharing organizations available at UniverCity and its respective costs and services.

UniverCity can utilize residence's high social media connectivity to organize residence seminar on car sharing and distribute car share information through posters, diagrams or charts (e.g. Diagram 3). That being said, incentives such as contests or prizes may provide more 'pull' factor for residences to add UniverCity to their social media network.

Improve Access

As illustrated in Diagram 1, the current location of car share fleets at UniverCity does not provide optimal walking linkages to residential buildings such as Nova 1 and One University Crescent.[7] In the survey comments, residences are deterred from the distance required to access the nearest car sharing vehicle. Figure 6 identifies potential locations for car share expansion to optimize walking access to car share vehicles. These include the east side of the east parking lot (adjacent to the bus station), and on-street parking at University Crescent adjacent to Serenity and Nova 1. These three locations will optimize site coverage of car sharing at UniverCity.for residences.

That being said, a review of Phase 4 development could be done to see whether it can implement car share specific parking to cater to the Phase 4 developments as well as to increase more access for existing residences.

(Figure. 6) Propose car share sites

Sponsorship and Incentives

Similar to the Community Transit Pass Program that ended in 2011, UniverCity should look into sponsorship of providing residences with memberships to car sharing companies. As the survey shows, only a quarter of the residences have a car share memberships. Without a membership, it is difficult for residences to try car sharing services. Most organizations often charge a signup fee ranging from $20-$75, and this may be already a deterrent for most. A trial period program or an

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[7] Buildings highlighted in red in Diagram 1

incentive to cover the sign up cost can allow residences to experience car sharing services and a program evaluation can be done to see whether or not such sponsorship can enhance car share usage.

Conclusion

Given UniverCity's growing population and development, it is critical to encourage alternative modes of transportation to reduce the number of vehicles on the road. car share represents an attractive alternative for residences who seek the conveniences of a personal vehicle without the heavy cost burden of actually owning a vehicle. The ongoing success of car share at UniverCity will rely on efforts to facilitate residences in understanding the cost/benefit of car share as well as to provide better access of vehicles for residences.

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