MANIPAL
ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

DEPARTMENT OF COMMERCE

MSCBA 612: Minor Project – I

"To analyze the feasibility of the e-cycle/e-buggy sharing system in MIT Campus, MAHE, Manipal, Karnataka''

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In the partial fulfillment for the award of the degree of

M.Sc. Business Analytics

Under the Guidance of

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DECLARATION

We hereby declare that this report titled "***To analyze the feasibility of the e-cycle/e-buggy sharing system in MIT Campus, MAHE, Manipal, Karnataka***'' is being submitted for the partial fulfillment of the requirements for the award of M.Sc. Business Analytics program of the Department of Commerce, Manipal Academy of Higher Education, Manipal, Karnataka and has no resemblance with any other person's work.

Thank You

With warm regards,

Kavya Chhabra - (212626023)
Vishal Rawat - (212626014)

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We would like to express my sincere gratitude to my guide Mr. Kishore L, Associate Professor, Department of Commerce, Manipal Academy of Higher Education for providing their valuable guidance and suggestions throughout this report.

Thank You

With warm regards,

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ABSTRACT

Recently, a floating e-bike, e-buggy service was initiated in the Manipal Institute of Technology, MAHE campus in Udupi, Karnataka, India. Brought to the campus by a Mangalore based company invested in Electric Vehicles called – Indeanta ventures ltd.

This study aims to find how successful the concept mentioned above is in MIT, Manipal. How adaptive the students, faculties, administration are to it, is it a long-term thing now in MIT and expansion of these services out of MIT into Manipal and expansion into more services which will eventually lead to installation of charging points and a bigger infrastructure.

A quantitative study has been performed to achieve the above objectives which consisted of taking data from the company involved in providing these services, data from the web and a cross sectional data from a survey conducted for knowing the experience and opinion of people using these services on campus about 2 months after installation of all the booths and the commencement of the service. The study is broadly divided into two parts: the first half is understanding how much students in MIT campus are preferring this concept using conjoint analysis. The second half is the expansion of first, it aims to explore further into the customer segmentation for the already existing system, what kind of people prefer such systems and whether the focus group is big enough to understand the customer expectations and to cater to more and more customers in the future.

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1 INTRODUCTION

The origin of electric vehicles goes way back to the 19th century. However, the speed of these electric vehicles was way too low, as a result EV's could not make their space in the market. Now, in the 21st century, pollution already being at an all-time high, hydrocarbon fueled vehicles are widely being replaced by electric vehicles due to their toxic emission and severe irreparable effects on the environment. EV's have gained popularity worldwide since the last decade. More and more automobile companies are jumping into the EV market and many newer companies are starting to come up in the market targeting only the EVs.

Walking or riding a bicycle inside huge campuses can be really exhausting as well as time-taking and will ultimately push people to ride motorbikes and cars on the campus. The launch of electric bikes within campus can solve the problems of exhaustion and save time. Many universities are adopting EVs (E-cars and E-bikes) for security patrolling in the campuses efforts to build a carbon neutral campus. These EVs has a good space to keep things intact. These EVs comes with a facility to charge necessary items like flashlights, gadgets, walkie-talkie.

It is scientifically proven that cycling makes you mentally and physically healthier. It helps create more neurons and neurotransmitters. Students who cycle to school display sharper memory skills, higher concentration levels, better thinking, and greater problem-solving ability than those who are sedentary.

At the Glasgow conference, conducted jointly by the United Kingdom and Italy, India pledged to achieve a carbon-free country by 2070. Many international leaders delivered remarks outlining aims for addressing the climate catastrophe. After China, the United States, and the European Union, India is the fourth largest emitter of carbon dioxide. In 2019, India produced 1.9 tons of CO2 per head of population. India has committed to get 50% of its energy from renewable sources by 2030, as well as reducing overall anticipated carbon emissions by one billion tons by the same year. **(Anuja Jadaun, 2022)**

One of the primary sources of carbon emission in India is the transportation industry contributing 13.5 per cent of India's energy related CO2 emissions. India is now mainly focusing to develop an EV ecosystem by providing policy support for manufacturers as well as for the consumers. Providing purchase discounts across several vehicle segments, reducing road tax, introducing scraping policy and giving incentives. Indian government launched various schemes like Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (Fame II) – Demand incentives,

Production – linked incentive (PLI) Scheme and on the state level many state governments are also giving various incentives for EVs.

Incentives offered by states include – Capital interest subsidy, tax exemptions, stamp duty reimbursements, states goods and service tax (SGST) reimbursement, provision of interest-free loans to incentivize EV manufactures. (**Times of India, 2021)**

Do universities really need electric mobility?

All university's standards include being environmentally friendly and achieving a particular level of sustainability. Various institutions are taking steps to comply with this standard and making internal movement electric will result in zero carbon emissions from intra-campus mobility. Going electric is a 100 percent green solution that leads in a much greener environment. The transition to electric bikes on campus would eliminate the problem of strain and will reduce the time it takes for individuals to get to their block from the classes or canteen.

The issue arises when these facilities are placed in a remote area of the campus and are underused to the point that most students are unaware of the available services. How good is a gym, a pool, a playground, a library, or a recreation center if it can't be easily accessed? An easy approach is to ride an electric cycle. Students must pace to reach their classes in a timely manner. **(ONN Mobility, 2019)**

INSTITUTES USING E-VEHICLES SERVICES:

1. Manipal Institute of Technology, Manipal:
2. Indian Institute of Science (IISc):
3. Indian Institute of Technology, Patna:
4. University of Mysore:
5. IIT Bhubaneswar:

2 OBJECTIVES

- To review the EV sharing service in the MIT campus of Manipal.
- To study the feasibility of the existing e-bike sharing service started in the MIT campus using conjoint analysis.

3 PROBLEM STATEMENT

The micro mobility system is a fairly new concept in Indian universities, we aim to understand the feasibility of the e-cycle/e-buggy sharing system in Indian universities, focusing on Manipal University, Manipal. We also aim to understand the challenges faced in implementing and sustaining a concept like that in Indian universities.

4 LITERATURE REVIEW

The combination of data from the RP and SP surveys with discrete choice and optimization techniques has revealed that the on-campus parking fare is a critical variable not only for reducing demand for private car travel but also for bolstering and financing alternative and more sustainable modes of transportation. The tariff could be raised if off-campus cruising time grows, but the ideal scenario would be to combine the on-campus charging policy with additional policies that translate a fare for parking on nearby streets, providing even more incentives to use more promising alternative modes of transportation. Additional policies that encourage sustainable mobility, such as new cycling infrastructure or public transit that provides a free shuttle service from off-campus parking lots to campus, might be funded using money earned from on-campus parking fees. **(dell'Olio, L., Cordera, R., Ibeas, A., Barreda, R., Alonso, B., & Moura, J. L., 2019)**

Both qualitative and quantitative methodologies are used to assess the state of existing facilities and strategies, as well as commuters' propensities for active modes of transportation on the Eastern Mediterranean University (EMU) campus. Several studies on commuters' modes of transportation to, from, and within universities have been undertaken, as well as studies on the emotional factors that impact commuters' decision to choose active modes of transportation. Furthermore, based on the other findings of this study, the effects of demographic factors (e.g., gender, age, living location, and education level) on improving the level of sustainability in the transportation sector by encouraging the use of active modes of transportation must be thoroughly investigated and considered for future studies. **(Dehghanmongabadi, A., & Hoşkara, S., 2018)**

A study was conducted for selection of an e-bike from two option considering the following attributes: trip time, trajectory, weather conditions, type of e-bike, and three work related variables (shower, secure parking, and financial intervention by the employer). Along with these e-bike specifications were also considered such as charging time, battery life, maximum speed, safe parking facility etc. As per the results weather is the dominant factor for e-bike consideration if the weather is bad people will not opt for e-bike. A safe parking space is also an important factor for selection. The speed and charging time are very important aspects for selection as they directly reduce the time consumption for the journey, but even if the option is providing these characteristics but not providing enough charging stations and safe parking spaces then the percentage of people opting for this option will reduce. Error! Reference source not found. **(Casier, C., & Witlox, F., 2022)**

The major reasons for students avoiding walking and taking transportation services like buses or e-cars which are university offered paid services, are weather and time. As it takes less than 20 minutes to walk one mile, it may not be a feasible reason but considering the behavior of students of not being proactive it might be a genuine reason. Hence the primary reason for not walking is the weather conditions. And as per the survey if the weather condition is good, students have more tendency to walk rather than taking a paid transportation service. Many students also bring up the issue of congested roadways, safety issues, and a shortage of bike parking. Many of the criticisms might be addressed by more sustainable infrastructure, particularly walking and bike paths. Error! R eference source not found. **(Kaplan, D. H., 2015)**

Sr. No.	Paper Title	Author	Methodology	Region/Audience	Attributes	Aim	Conclusion
1	An Analysis of Trip Preferences among E-bike Users in Commuting: Evidence from an Online Choice-based Conjoint Experiment	Corneel Casier, Frank Witlox	SP Survey, Conjoint Analysis, no-choice binomial logit model	Flanders, Belgium / Commuters	Trip time, Weather Conditions, type of e-bike, cycle infrastructure, facilities at the workplace	Identify which combination of a small number of variables has the most impact on a respondent's choice of a product or service.	

2	Transportation Sustainability on a University Campus	David H Kaplan	SP Survey	Kent State University and Kent, Ohio/Students	Weather, shortage of bike parking, time, safety issues	To analyse which aspects are important for students to decide between walking and opting for e vehicle	The major reasons for students avoiding walking and taking transportation services like buses or e-cars which are university offered paid services, are weather and time.
3	A Study on the Adoption of Electric Vehicles in India: The	Anil Khurana , V. V. Ravi Kumar,	Structured equation modelling,	India/Customers	cost of the EV, driving distance per	To justify the feasibility and sustainability of e-vehicles	The PEB is unrelated to the BI to embrace EVs, according to

	Mediating Role of Attitude	Manish Sidhpuria	Factor Analysis, Hypothesis		charge, time to recharge the battery, availability of charging points and battery cost.	in Indian market	the study. Rather, it has a significant favorable impact on ATT.
4	College Students Choice Behavior of Electric Two Wheeled Vehicle	Rong-Chang Jou, C. W. Lin, P. L. Wang	The discrete choice model, mixed logit (MXL)	Taiwan/Students	Vehicle Types, Trip purpose, Travel Time/Distance, Costs		"Gender," "personal income," and "acceptable ETWV pricing" are some of the criteria that determine the ETWV vehicle scheme decision.

5 METHODOLOGY

The purpose of this study is to find out the feasibility of the newly started e-cycle/e-buggy sharing facility in the MIT campus of Manipal Academy of Higher Education, Manipal, Udupi, Karnataka, India.

Our chosen methodology is conjoint analysis and linear regression model.

5.1 DESIGN OF RESEARCH:

A survey was sent across to the students of Manipal Academy of Higher Education. The survey consisted of two sections.

The first section included the personal details of the respondents like age, gender, education level, if they have used the e-cycle/e-buggy sharing system, are they aware about the facility, how do they like the facility in the campus etc.

The second section included the conjoint based questions. There were 10 total conjoint based questions. Each question included a conjoint card which basically related to a real-life scenario and if it were to happen how likely a respondent was to use the service with the given features. The respondents were to rate the situation/card on a scale of 1 – 10.

The conjoint cards were generated using the conjoint package on R-studio. A total of 10 cards were generated for the 10 questions in the survey. The cards consisted of 5 attributes namely,

Weather: The weather was taken considering the weather at Manipal which is mostly sunny or rainy.

Vehicle type: The vehicle type are the two types of vehicles that the current facility provides; E-bike/e-buggy.

Booth accessibility: The booth accessibility plays another important role in defining the feasibility of service, there are so far only 2 booths in the MIT campus and hence, we aim to see how the booth's distance from the hostels/department building affect the preference3 of the service by the respondents.

Trip fare: Another important attribute to take in account is the fare for each ride that a student takes with the e-bike/e-buggy

Number of trips: This the number of trips that a student would have to or would prefer to take using the facility.

Each attribute had multiple levels to it, all the attributes with their corresponding levels are given in the table below:

Table 5-1

ATTRIBUTES	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
WEATHER	Sunny	Rainy		
VEHICLE TYPE	E-cycle	E-buggy		
BOOTH ACCESSIBILITY	Near	Far		
TRIP FARE	Rs. 10	Rs. 20	Rs. 30	
NUMBER OF TRIPS	1	2	3	4

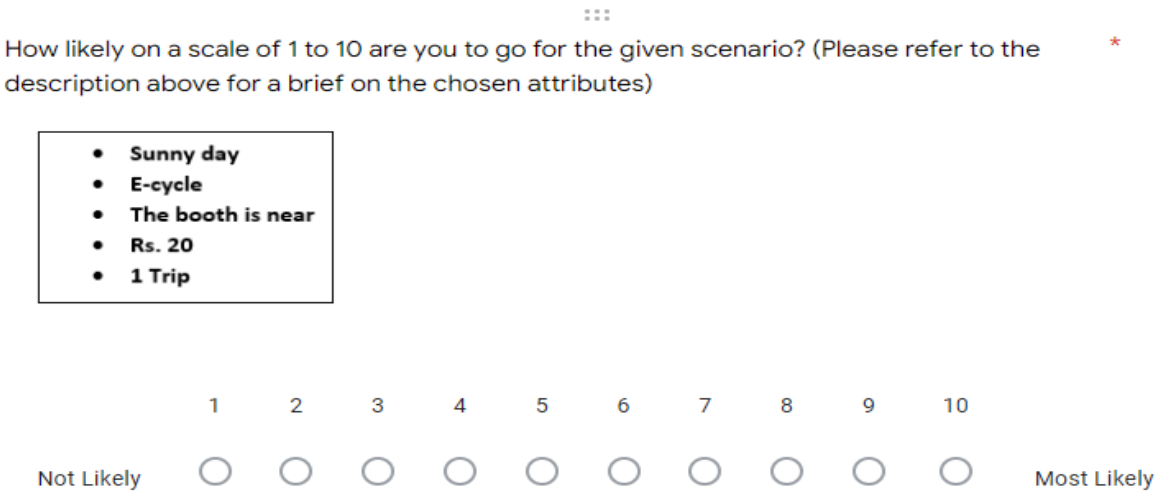

Figure 5-1

example of the rating-based question in the survey distributed.

All respondents were given the same survey with the 10 choice cards to rate each of them on a scale of 1-10. All cards consisted of levels of the 5 attributes taken. The choice of the taken attributes were taken from a few studies mentioned in the review of literature **(Casier, C., & Witlox, F., 2022)** analysis of preference among e-bike users.

5.2 TESTS CONDUCTED:

To analyze the responses obtained from the survey, we used conjoint analysis. Conjoint analysis is used to understand how consumers value different features of a product/service. We used the conjoint package in R programming that gives us the preference analysis of the respondents regarding the e-cycle/e-buggy service based on the responses we got from the survey conducted, the analysis basically is derived from the multiple linear regression model.

The conjoint package gives us the following information through various functions within the package:

1. Conjoint analysis model coefficients also called the part utilities of the variables and the aggregated model. The coefficients so obtained tells us about what attribute has the most effect on the preference of the respondents.

2. Estimation of the importance of the attributes/variables taken at their respective levels.

3. Theoretical feasibility of the service/product.

Note: Here we take in the assumption that the preferences followed normal distribution without any correlations among the variables.

6 BENEFITS:

6.1 GENERAL (Niti Aayog)

6.1.1 Low Running Costs: -

The operational costs of an electric vehicle are far cheaper than those of a gasoline or diesel vehicle. Electric vehicles charge their batteries with electricity rather than fossil fuels like gasoline or diesel. Electric vehicles are more fuel efficient, and when the cost of electricity is included in, charging an electric vehicle is less expensive than filling a gasoline or diesel vehicle for the transportation needs. Using renewable energy sources, electric automobiles might be made more ecologically friendly. The cost of power can be further decreased if charging is done at home with renewable energy sources such as solar panels.

6.1.2 Low maintenance cost: -

Electric vehicles have lesser moving parts than internal combustion engines, which means they require less maintenance. Electric vehicles require less maintenance than traditional vehicles. As a result, the yearly expenses of owning and maintaining an electric vehicle is quite low.

6.1.3 Easy to drive and quiet: -

Electric vehicles don't have outfits and are extremely helpful to drive. There are no convoluted controls, simply speed up, brake, and steer. At the point when you need to charge your vehicle, simply plug it into a home or public charger. Electric vehicles are additionally peaceful, so they diminish the clamor contamination that conventional vehicles add to.

6.1.4 Convenience of charging at home: -

Imagine being stuck in a crowded gas station during rush hour, and you're running late for work. With an electric car, these issues can be readily solved. Simply leave your vehicle plugged in for 4-5 hours at your home charger before you go. It is quite simple to

plan your excursions in advance if you can acquire a charger where you park at home. What happens if you fail to connect your machine in at some point? If you're riding a two-wheeler on the road, you may simply use quick chargers or even battery changing services.

6.2 ENVIRONMENTAL

6.2.1 No noise pollution: -

Electric vehicles have the quiet working capacity as there is no motor in the engine. The electric engine works so quietly that you really want to investigate your instrument board to check assuming it is ON. Electric vehicles are quiet to the point that producers need to add misleading sounds to make them ok for people on foot. **(Niti Aayog)**

6.2.2 Cleaner CO2 emission: -

Tailpipe emissions have a harmful impact on the air quality. The CO2 emissions of electric vehicles, however, are much cleaner compared to the emissions from the most eco-friendly petrol engines. As per the U.S. Department of Energy, fully electric vehicles emit an average of 4,450 pounds of CO2 each year while conventional cars emit over twice as much annually. **(Mallika Rangaiah, 2020)**

6.2.3 Zero tailpipe emissions: -

The greatest component making electric vehicles a resource is that EV's that sudden spike in demand for power radiate zero tailpipes (direct) emanations. The outflows from driving electric are undeniably less from the ones brought about by driving petroleum or diesel. With EVs getting more pervasive and their assembling more far reaching, battery reusing has the extent of getting more effective and diminishing the requirement for extraction of new materials, subsequently lessening the reliance on mining and creation of new batteries. EVs produce impressively lower emanations over their lifetime than vehicles running on petroleum derivatives, independent of the source that creates the power. ***(Mallika Rangaiah, 2020)***

7 BARRIERS: -

7.1 CHARGING PROBLEM *(Radhika, 2020)*

7.1.1 The Standards of Fast Charging for Electric Vehicles: -

Electric car fast charging is regarded as a difficult and well-organized technology. Fast-charging EVs with standard power levels require six to eight hours to achieve fully charged batteries. Fast charging cuts the charge time in half, to about thirty minutes. EVs require a source of AC and DC power to charge their batteries, and this incredible feat comes with certain constraints. A power grid is frequently used to provide this kind of energy.

7.1.2 Economic and Infrastructure Issues: -

Technical difficulties must be overcome in both the economic and infrastructure concerns that are preventing the successful implementation of rapid charging for electric cars; access to charging infrastructure must be improved. Fast charging on this timetable must occur at a cost that is affordable to customers, who consider a lack of efficient charging stations as the third most critical obstacle to acquiring an electric vehicle.

7.1.3 Convincing Utility Providers: -

Convincing utility companies to shift their business models as we move toward a renewable-energy-powered society will be difficult. Electricity companies face an issue with EV charging stations since they require a lot of electricity. If that isn't enough, the suppliers will be required to contact each carmaker that uses the charging station and notify them that their power use must be quantified.

This problem can only be overcome if all EV manufacturers band together to develop a neutral platform, like a central server, so that utility companies only have to send one load reduction request. The manufacturer will be able to reply appropriately, making life easier for everyone concerned.

7.2 PEDESTRIANS

7.2.1 Small Footpaths:

The footpaths constructed on the roads inside the campus are not wide enough. So, during the peak times like morning, lunchtime and evening the footpaths get overcrowded, hence the pedestrians occupy some portion of the road also. This creates an issue for the vehicles, the E-vehicles get less road space for operation.

7.2.2 Accidents:

During peak times, there is a rush in E-vehicle services and a high number of pedestrians are also there, so there is a risk of accidents. As the pedestrians occupy part of the road, the probability of an accident increases. However safe the drivers may drive, but the possibility of accident still exists due to the uncertain situations.

7.3 BATTERY

7.3.1 Loading:

When the vehicle is climbing a hill in full occupancy, an extremely high load is acting on the motor and consequently on the battery. If such events take place frequently, it may cause degradation in battery health.

7.3.2 Heating:

In case of battery overloading, there is a high heat generation in the battery. Due to overheating, heat accumulation may take place and if the amount of heat accumulated reaches a very high level, then there is a chance of sudden failure or even explosion.

7.3.3 Water Impregnation:

Even though the battery and electronics housing are IP certified, there always exists a possibility that water may enter the electronics unit and cause a short circuit which may cause malfunction or failure of the system.

8 RESULTS AND DISCUSSION:

8.1 PREREQUISITE ANALYSIS OF THE SAMPLE:

A sample of 102 respondents was collected from the above survey. Out of which, 3 responses were omitted, since the respondents had filled the same rating for all cards which is not a valid response and hence, a sample of 99 was taken forward for analysis. The survey consisted of a few general and daily commute related questions to know the characteristics of the respondents and their daily travel habits.

There were relatively more men than women that were part of the sample. About 74% of respondents were male and 26% were women.

The data also shows that the age group of the respondents is between 17-40, however most of the Respondents are between the age group of 18-24, 30% of the respondents are within the age group 18-20, 40 % are within the age group 20-22, 21% are within the age group 22-24, 8% are within the age group 24-26 and 1% within the age group of 38-40. The below bar graph shows the age distribution of the respondents:

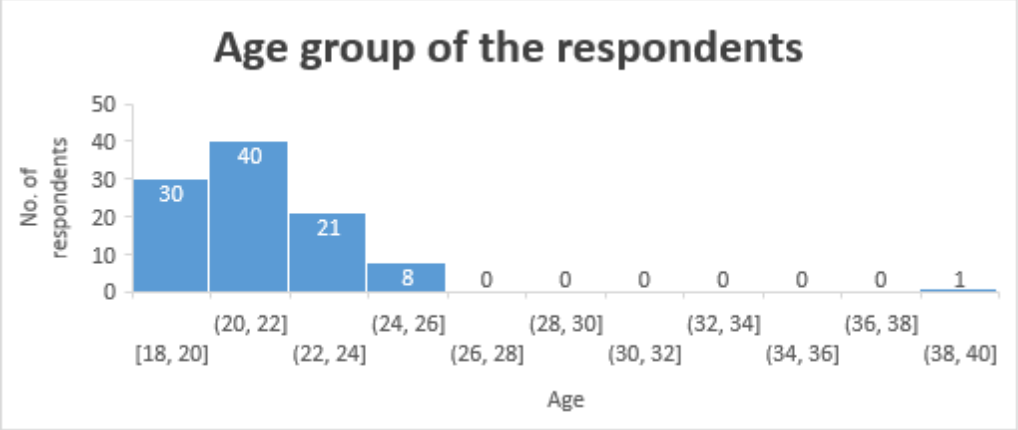

Figure 8-1

Another characteristic of the respondents collected was the current education level/ the degree they are pursuing at MAHE. The education level was divided into 4 categories

namely, UG (Under graduation), PG (Post Graduation), Diploma and PhD. The distribution of the data was 43%, 52%, 1% and 4% respectively.

The data further goes onto show that 91.9% respondents know about the e-cycle/e-buggy facility in the MIT campus, while only 50% of the respondents have used the service at least once.

Another factor known to us from studying the data is the likability of the e-cycle/e-buggy facility. The usual mode of commute chosen by respondents is walking (83%), second is owned bicycle (11%), third is using the e-cycle/e-buggy (4%) and fourth is using an auto (2%). However, the respondents show an interest in the e-cycle-e-buggy facility, 43.4% would prefer to use the facility over owning a bicycle and about 71% would choose to sometimes or most definitely chose the facility if owning a bicycle was not an option. This does encourage the study as mostly people who walk on a usual around the campus would be our focus group, which is the majority and many of them have shown a keen interest in using the given facility maybe with a few improvements, that's what we aim to study through the following conjoint analysis; what attributes/features are preferred/not preferred by the respondents.

The following table describes the respondent's characteristics and their opinion about using the e-cycle/e-buggy service:

Table 8-1

CHARACTERISTICS OF DAILY COMMUTE	CATEGORIES	PERCENTAGE
GENDER	Female	26.5%
	Male	73.5%
	Others	0%
AGE	18-20	30%
	20-22	41%

	22-24	19%
	24-26	8%
	38-40	1%
DEGREE CURRENTLY PURSUING	UG	43.1%
	PG	52%
	Diploma	1%
	PhD	3.9%
DO YOU KNOW ABOUT THE E-BUGGY/E-CYCLE FACILITY	Yes	91.9%
	No	8.1%
USED THE FACILITY ATLEAST ONCE	Yes	50%
	No	50%
USUAL COMMUTE MODE	Walk	83%
	Own Bicycle	11%
	Public Transport/Auto	2%
	E-cycle/E-buggy	4%
PREFERENCE TO OWN A BICYCLE OR USING AN E-CYCLE/E-BUGGY	Owning a bicycle	56.6%
	e-cycle/e-buggy	43.4%
PREFERENCE TO WALKING OR USING E-CYCLE/E-BUGGY (IF OWNING A CYCLE IS NOT AN OPTION)	Walk	29%
	E-cycle/E-buggy	32%
	Sometimes e-cycle/e-buggy	39%
DO YOU LIKE THE E-CYCLE/E-BUGGY SERVICE	Yes	73.7%

	No	26.3%
DO YOU FIND IT A COOL FACILITY	Yes	75%
	No	25%

8.2 CONJOINT CARDS:

To begin with conjoint, the conjoint cards were generated using R conjoint package. A total of 10 cards were generated for the survey taking in the five attributes: Weather, Vehicle, Booth Accessibility, Fare, Number of trips with their respective levels.

Cards:

```
##    weather vehicle booth_accessibility trip_fare trip_frequency
## 7    sunny e-buggy                 far      Rs10             1t
## 9    sunny e-cycle                near      Rs20             1t
## 24   rainy e-buggy                 far      Rs30             1t
## 26   rainy e-cycle                near      Rs10             2t
## 39   sunny e-buggy                 far      Rs20             2t
## 55   sunny e-buggy                 far      Rs10             3t
## 62   rainy e-cycle                 far      Rs20             3t
## 67   sunny e-buggy                near      Rs30             3t
## 84   rainy e-buggy                near      Rs20             4t
## 93   sunny e-cycle                 far      Rs30             4t
```

Table 8-2

Further, we create 3 different .csv files for conjoint analysis:

1. EVlevels: consisting of all the levels of the chosen attributes.
2. EVProfiles: Consists of the 10 profiles/cards generated.
3. EVPref: matrix of the ratings given by the responses for the 10 profiles/cards.

8.3 CONJOINT MODEL:

Using the function conjoint() we obtain the conjoint model; through this model we test the significance of each level of every attribute based on the respondent's preferences.

Conjoint model:

```
##
## Call:
## lm(formula = frml)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -6,475 -1,396  0,633  1,769  5,604
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     6,542929   0,089609  73,017  < 2e-16 ***
## factor(x$weather)1              0,305556   0,087994   3,472 0,000538 ***
## factor(x$vehicle)1             -0,007576   0,087994  -0,086 0,931409
## factor(x$booth_accessibility)1  0,154040   0,087994   1,751 0,080331 .
## factor(x$trip_fare)1            0,621212   0,131174   4,736 2,50e-06 ***
## factor(x$trip_fare)2            0,111111   0,117325   0,947 0,343854
## factor(x$trip_frequency)1      -0,962963   0,138614  -6,947 6,79e-12 ***
## factor(x$trip_frequency)2      -0,045455   0,168496  -0,270 0,787396
## factor(x$trip_frequency)3       0,043771   0,138614   0,316 0,752240
## ---
## Signif. codes:  0 '***' 0,001 '**' 0,01 '*' 0,05 '.' 0,1 ' ' 1
## ## Residual standard error: 2,61 on 981 degrees of freedom
## Multiple R-squared:  0,09198,    Adjusted R-squared:  0,08458
## F-statistic: 12,42 on 8 and 981 DF,  p-value: < 2,2e-16
```

Table 8-3

From the above model we interpret:

- The factor weather: sunny is highly significant with a p-value of 0.000538 and coefficient as 0.30556, suggesting that the service is way more preferred by the students when the weather is clear and sunny as compared to on a rainy day.

- The factor booth accessibility: Near with the coefficient 0.1540 is moderately significant at a p-value of 0.080331 which implies that the booth being near is preferred by the students, but it isn't the major factor of preference for the service.

- The factor Trip Fare: Rs. 10 is also highly significant with the coefficient 0.621212 at a p-value of 2.50e^-6, which suggest that a low trip fare is preferred by the students.

- The factor trip frequency: 1t is another highly significant factor here with the coefficient value as -0.962963 at a p-value of 6.79e^-12 implies that students would actually prefer the facility lesser when they only have to take, I trip a day.

- The F-statistic obtained is 12.42 on 8 and 981 degrees of freedom at a p-value of less than 2.2e^-16, this suggests that the f-statistic is significant and hence, the joint effect of all the attributes is significant, and the model is a good fit.

8.4 PART UTILITIES OF LEVELS AND AVERAGE IMPORTANCE OF ATTRIBUTES:

Since we have obtained a significant model and observed the effect of the factors most relevant, we further go on to study the part worth utilities of each level and the average importance of the attributes.

Part utilities are scores that quantify the effect of each level/feature effects the consumers decision towards a service/product.

Average importance of attributes shows which attribute as a whole influences a consumer's decision.

Part worth utilities of levels:

```
## [1] "Part worths (utilities) of levels (model parameters for whole sample)
:"
##        levnms    utls
## 1   intercept  6,5429
## 2       sunny  0,3056
## 3       rainy -0,3056
## 4     e-cycle -0,0076
## 5     e-buggy  0,0076
## 6        near   0,154
## 7         far  -0,154
## 8        Rs10  0,6212
## 9        Rs20  0,1111
## 10       Rs30 -0,7323
## 11         1t  -0,963
## 12         2t -0,0455
## 13         3t  0,0438
## 14         4t  0,9646
```

Table 8-4

From the part utilities we can interpret how each level of the attribute effects a consumer's decision.

- Weather: sunny has a utility of 0.3056 while the level rainy has a utility of -0.3056 implying the weather sunny has a positive influence on the consumer while rainy will have a negative effect on the consumer's decision.
- Similarly, for vehicle choice of e-cycle and e-buggy the utilities are -0.0076 and 0.0076 respectively suggesting that e-buggy is preferred over an e-cycle, but the attribute's influence is quite less.
- Booth accessibility: near and far have utilities 0.154 and -0.154 respectively implying a nearby facility of booth is preferred over a faraway one and it has a significant effect on the choice.
- The trip fares: Rs. 10, Rs. 20 and Rs. 30 have utilities 0.6212, 0.1111 and -0.7323 suggesting Rs. 10 or Rs. 20 are preferred costs while Rs. 30 is the least preferred cost. Simply, a lower cost is most preferred by the students.
- Lastly, the number of trips: 1 trip, 2 trips, 3 trips and 4 trips have utilities -0.963, -0.7323, 0.0438, 0.9646; suggest that the consumer tends to prefer the service of an e-cycle or an e-buggy more when he/she has to go back, and forth multiple times compared when they have only 1 or 2 trips to make in a day.

8.5 AVERAGE IMPORTANCE OF ATTRIBUTES:

```
## [1] "Average importance of factors (attributes):"
## [1] 16,06  8,65 12,70 23,98 38,61
## [1] Sum of average importance:  100
```

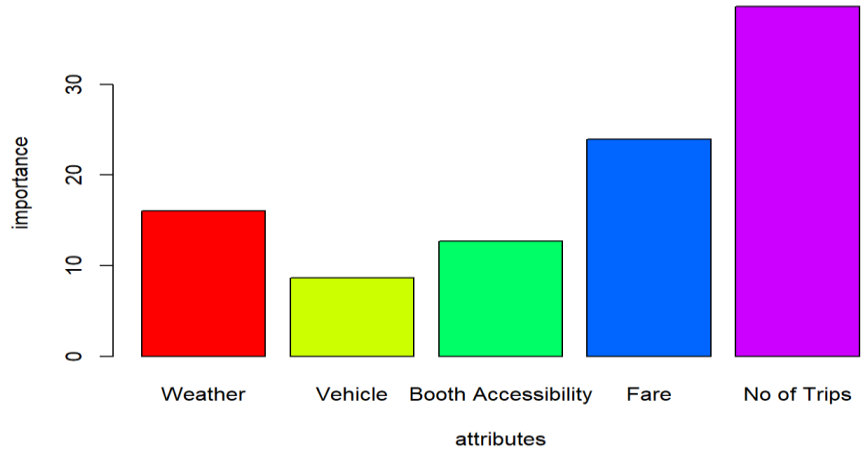

Figure 8-1

From the above average importance scores and the bar plot of the average importance of the attributes, we can clearly understand how each of the attributes have an effect on the consumer's decision, The number of trip required to make in a day has the most effect according to the above results with a score of 38.61, followed by fare which comes next as the attribute that influences the decision of using a facility with a score of 23.98, third most important attribute is the weather with a score of 16.06, fourth is the booth accessibility with 12.70 as the score and finally the vehicle type is the least influential attribute with a score of 8.65. indicating, the number of trips, the fare of each ride and the weather on a given day has the most influence on a consumer while the booth accessibility has a moderate effect, suggesting improvements but not too crucial and the vehicle type has the least effect on a consumer's decision.

9 CONCLUSION AND FUTURE WORK

9.1 CONCLUSION

The above results, we understand the consumers are most definitely affected by all the attributes. Out of which, the fare of each ride and the booth accessibility are the key problem areas, the price of each ride when higher than Rs. 20 makes the consumer not take the service and so does the booth accessibility, a nearer booth is preferred by the consumers, however the in a 188-acre campus, there are only two booths currently operating which makes the booths farther for most people and hence it is one challenge that needs to be tackled.

Weather and number of trips are other two factors that have shown influence on the consumers. This influence can be tackled by adding more buggies as it is more preferred especially during rainy season. The number of trip attribute suggests that the consumers are only taking the service when the number of trips are more, with a possible reduction in trip fare and increase in the number of buggies going around, consumers would not hesitate in taking the service for any number of times in any situation.

9.2 LIMITATIONS AND FUTURE WORK

The main limitation of this study is that it is done on very small group of consumers, with a larger sample size, the results can be more promising. This micro mobility service is a very new concept for Indian universities, hence not a lot of research has been done on it, further work can be done for different universities of India and can be taken forward by studying the effect of the attributes on different segments of people and studying the segmentation of the consumers.

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ANNEXURE A: - GOOGLE FORM

LINK: https://forms.gle/LDmoNW4XsM5vf3SC7

Study to analyze the feasibility of the e-cycle/e-buggy sharing system in MIT Campus, MAHE, Manipal, Karnataka

Section 1:

Hi all!

This survey is in regard with a study conducted by Kavya Chhabra and Vishal Rawat, 1st year students of MSc Business analytics, DOC, MAHE for our minor project for the semester.

This study is on the topic: "Analyzing the feasibility of the e-cycle/e-buggy sharing system in MIT, MAHE". The study is being conducted to understand the perspective of the students on campus about the recently initiated E-cycle/e-buggy sharing system and how sustainable it is.

The responses to this survey will be used for the same analysis and will constitute to a major help in our study.

Please note: This is an anonymous survey, and the information provided will solely be used for this study.

Please fill the survey to the best of your knowledge, your input is really important to us and we really appreciate you taking out time to fill this for us!

Only for MAHE students

Q1. Age (In years)

_____

Q2. Gender

- Male
- Female
- Others

Q3. Degree

- UG
- PG
- PHD

Q4. Do you know about the e-cycle/e-buggy renting system recently started in MIT?

- Yes
- No

Q5. How do travel inside the MIT campus?

- Walk
- Own cycle
- Public transport/auto
- E-cycle/e-buggy

Q6. Have you ever used the e-cycle/e-buggy?

- Yes
- No

Q7. How much do you usually spend on one trip?

_____

Q8. Would you prefer owning a bicycle inside the campus or using the e-cycle/e-buggy service for daily commute?

- Owning a bicycle
- E-bike/e-buggy

Q9. If owning a bicycle is not an option, would you prefer the e-cycle service?

- Yes
- No, I rather walk
- Sometimes

Q10. Do you like the e-cycle/e-buggy service?

- Yes
- No

Q11. Do you find the e-cycle a cool facility?

- Yes
- No

Section 2:

The survey is based on conjoint analysis for which in this part of the survey.

Conjoint cards are used for the analysis, we take up different attributes and their subsequent levels and using design of experiment, these cards are formed.

The following questions, cards are given that relate to a scenario in real life and on a scale of 1-10, you need to fill in how likely is that scenario for you.

the attributes so taken are explained below for your understanding:

1. Weather: the weather affects what type of commute you'd prefer on a given day, sunny and rainy are two levels for it.

2. Type of vehicle: the e-cycle or the e-buggy, which one you'd prefer on a given day.

3. Booth accessibility: so as of now, there are two booths located inside the MIT campus from where you can rent the e-cycle or catch the e-buggy from. The levels for booth accessibility are far or near.

4. Fare: The fare of one-time use of any of these services is taken as the next attribute. it is divided into 3 levels, Rs. 10, Rs. 20, Rs. 30.

5. Number of trips: This is the number of times in a day you would use this service for your commute on a daily.

Q12. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-Buggy**
- **The booth is far**
- **Rs. 10**
- **1 Trip**

1	2	3	4	5	6	7	8	9	10

Q13. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-cycle**
- **The booth is near**
- **Rs. 20**
- **1 Trip**

1	2	3	4	5	6	7	8	9	10

Q14. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Rainy day**
- **E-Buggy**
- **The booth is far**
- **Rs. 30**
- **1 Trip**

1 2 3 4 5 6 7 8 9 10

Q15. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Rainy day**
- **E-cycle**
- **The booth is near**
- **Rs. 10**
- **2 Trip**

1 2 3 4 5 6 7 8 9 10

Q16. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-Buggy**
- **The booth is far**
- **Rs. 20**
- **2 Trip**

1 2 3 4 5 6 7 8 9 10

Q17. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-buggy**
- **The booth is far**
- **Rs. 10**
- **3 Trip**

1 2 3 4 5 6 7 8 9 10

Q18. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Rainy day**
- **E-cycle**
- **The booth is far**
- **Rs. 20**
- **3 Trip**

1 2 3 4 5 6 7 8 9 10

Q19. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-buggy**
- **The booth is near**
- **Rs. 30**
- **3 Trip**

1 2 3 4 5 6 7 8 9 10

Q20. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Rainy day**
- **E-Buggy**
- **The booth is near**
- **Rs. 20**
- **4 Trip**

1 2 3 4 5 6 7 8 9 10

Q21. How likely on a scale of 1 to 10 are you to go for the given scenario? (Please refer to the description above for a brief on the chosen attributes)

- **Sunny day**
- **E-cycle**
- **The booth is far**
- **Rs. 30**
- **4 Trip**

1 2 3 4 5 6 7 8 9 10

ANNEXURE B: - PLAGIARISM