

# Urban Transportation: A Case Study on Bike-Sharing Usage in Klang Valley

Siti Norida Wahab<sup>#1</sup>, Rohana Sham<sup>#2</sup>, Amir 'Aatieff Amir Hussin<sup>#3</sup>, Shakerin Ismail<sup>#4</sup>,  
Salini Devi Rajendran<sup>#5</sup>

*#Faculty of Business and Information Science, UCSI University  
56000 Cheras, Kuala Lumpur, Malaysia*

<sup>1</sup>sitonorida@ucsiuniversity.edu.my, <sup>2</sup>rohana@ucsiuniversity.edu.my,  
<sup>3</sup>amir@ucsiuniversity.edu.my, <sup>4</sup>shakerin@ucsiuniversity.edu.my,  
<sup>5</sup>salinidevi@ucsiuniversity.edu.my

**Abstract**— The principal aim of this paper is to empirically investigate the bike-sharing usage among Klang Valley citizen. Data for this study were collected using an online questionnaire survey. However, due to the low responses, simulations have been used and applied to predict the outcomes of the research. The simulated data was generated based on a uniform selection of a random element that simulated the answers of the potential questionnaire respondents. We limited the number of responses to 350 respondents. Correlation analysis was applied to analyze the data collected. The factors affecting the bike-sharing usage are availability, safety, convenience cost and enjoyment. Convenience is found as the only variable that influences the bike-sharing usage among Klang Valley citizen. The findings contribute towards an understanding of factors that may encourage people to shift from an automobile to bike-sharing as an alternative towards a sustainable transportation option. In theoretical contribution, the developed theoretical framework presents a platform for future empirical bike-sharing studies and extend previous research conducted in Western countries. This research shows that bike-sharing is important in embracing non-motorized means of transport towards reducing the environmental pollution and acknowledgement towards the reduction in road congestion, accidents, and other social and environmental problems. Findings from this study will help practitioners implement strategies with greater potential in increasing the attractiveness of bike-sharing and improve the sustainability of land use and transportation systems.

**Keywords**— *Bike-Sharing, Urban Transportation, Theory of Routine Mode Choice Decisions*

## 1. Introduction

The concept of urban transportation is gaining popularity in many urban cities. An important part of the urban transportation system is the public bicycle systems, popularly known as the bicycle sharing systems has been introduced in most cities. The main objective of introducing bicycle sharing systems is to widen the accessibility of public

transportation in a greener way. This becomes important as most of the cities in developing countries face the unavoidable problems in implementing a sustainable transport system [1]. Innovation in city transportation system creates public bicycle systems to meet the needs of riders. This system integrates with another mode of transportation to provide the riders affordable and easy access to travel in the city [2]. The idea of a bike-sharing system is that the riders can ride the bicycles whenever they need them and leave them when they reach their place [2]. Bike sharing systems motivate the public to ride bicycles to travel within a short distance. This system would reduce the number of cars and motors on the road and directly reduce traffic congestion. Furthermore, noise and air pollution can be reduced through the implementation of bike sharing.

Today, traffic congestion is a major problem in areas around the Klang Valley. According to Malaysia Automotive Association (MAA), a total number of 289, 714 units of vehicles including passenger cars and commercial vehicles have been registered till June 2018 [3]. There are two types of traffic congestion, the first one is related to commuters come from the urban area around the city and occurred in highways and roads approach to Kuala Lumpur central. The other is related to commuters, visitors, tourists and foreign students those come to Kuala Lumpur central with a taxi or their own cars. Klang Valley facing heavy traffic in most of the hotspots areas such as Jalan Bukit Bintang, Jalan Raja Chulan, Jalan Ampang, Jalan Pudu and many other areas because of the high usage of cars and motors. The government has announced several policies and programs to reduce these congestions but bike sharing is one of these solutions that work efficiently because it is appropriate and sufficient to accommodate these areas [2].

Bike-sharing is gaining global attention in recent years with the aims of increasing cycle usage, improving the first or last mile connection and

alleviating the environmental impact. Malaysia together with other world leaders has adopted sustainable agenda towards becoming a developed nation [4]. In Malaysia, the government has acknowledged that transportation and mobility as a crucial element towards the sustainable development. Due to that, part of the strategy under by the 11th Malaysia Plan is to encourage low carbon mobility which emphasizes on the usage of public transport [5]. Bike-sharing seen as a way to promote the viability of public transport. [6] identified that the benefits of bike-sharing include road congestion and fuel use reduction, emission reductions, flexible mobility, physical activity benefits, individual financial savings and support for multimodal transport connections.

Data generated from [7] identified that cycling and walking resulted in zero gram carbon dioxide equivalent per kilometre in comparison to other modes which is 45.6 by rail, 66.8 by bus, 124.5 by car (single occupant) and 130.2 by airplane. For short length trips, bike-sharing is fast, flexible and efficient alternative compared to private vehicles and public transport. For long length trips, bike-sharing offer an option for the first and last mile journey, provide further transportation alternatives, promote cycling in general and raise awareness. In short, bike-sharing can fill an important niche in the urban transportation system [8].

One of the critical issue being highlighted in the [9] is the high travel demand in Malaysia which is associated with the private transportation. Subsequently, this has resulted in a high volume of traffic on the road, leads to road congestion, pollutions as well as road accidents. The number of accident rate involving the bicycle users is at a declining rate as compared to other forms of transport especially car and motorcycle which has grown triple in numbers. This should be one of the positive factors of attraction in the near future of why bike-sharing is the best solution for travel in an urban area [10]. Additionally, private car usage also contributes to a higher level of world major pollutants in Particulate Matter (PM<sub>2.5</sub>), which pose the most serious threat to human health [11]. Hence, the bike-sharing activities are important to release the government objective towards the sustainable developing nation.

The Climate Change Performance Index [12] reported that Malaysia ranks at 55th out of 61 countries to be the worst performers with a score of 32.61 with a high level of Greenhouse Gas (GHG) emissions. Likewise, Malaysia's emission levels have been escalating since the year 2000 [13]. Currently, there are approximately 750 million cars in the world, and if the demand for cars continues increasing, it is predicted that this number will double in the next 30 years. There will be never-

ending environmental damage caused by vehicles as well as accidents and congestion in countries [14].

Bike-sharing may change the cities of Malaysia in infrastructure, congestion problems, air pollution and will remit environmental, economical, and social benefits through low carbon emission. Cycling causes virtually no environmental damage, takes up little space, promotes health through physical activity and is economical, both in direct user costs and public infrastructure costs [15]. Altogether, cycling is environmentally, socially and economically sustainable. According to the registered user data of oBike and Mobike, there are currently more than 300,000 riders for its bike-sharing programs. Even though the number looks promising, the acceptance rate is relatively very low when compares the population of Klang Valley, with only 4.16% usage were reported.

The scope of this research paper is limited to an individual as a unit of analysis. Respondents in this study are the public in Klang Valley who are using bike-sharing services. The prime reason for this study's location to be Klang Valley is because oBike and Mobike are both functioning in this city and have amassed a considerable large number of riders. Secondly, Klang Valley is the largest city of Malaysia in population. The city covers an area of 243 square kilometres and has an estimated population of 1.73 million as of 2016 [16].

## 2. Literature Review and Hypotheses Development

### 2.1 Issues of Investigation

Bike-sharing has rapidly evolved and adapted to changing environmental, technological and economic factors [17]. Bike-sharing programs have almost become permanent facilities in western urban landscapes. However, the introduction of such schemes in Asia has been limited and relatively new concept in Malaysia [6]. Even though the bike-sharing program is in its infancy in Malaysia, the companies offering these programs have already started facing issues when it comes to the use of its bicycles.

One major setback is when some users leave the bikes strewn everywhere from bus stops to footpaths to their houses, instead, to the designated parking spots. This cause obstruction to the road passage. Additionally, lack of fixed docking stations leads to the bicycle being haphazardly vandalized. [18] added that the users have been abusing the use of the bike-sharing facility. Additionally, lack of cycling culture is one of the main concerns for the bike user [19].

Despite the best intention is to encourage people to cycle, the dedicated bicycle lanes in Kuala Lumpur city centre has drawn flak from the public as it appears to cause inconvenience to both cyclists and motorists. Lack of awareness among motorists who park illegally and lack of enforcement defeats the project's objectives. In addition, pedestrian, and cycle networks are not fully developed, although progressive efforts are being made to promote cycling habit, it is still not widely adopted in Malaysia. Less attention is paid to the impacts of motorized transport hence, non-motorized transport is still the least common means of transport [20].

Safety is another major concern for cycling in Malaysia. Lack of designated lanes with many cyclists riding on pavements puts the riders as well as others in a dangerous situation. The existing cycle lanes in the major cities are not consistent. Their positions vary from the left and or on the right side of the roads. Cyclist should ride on the left side of the road; however, the left side is often filled with gravel, dirt, uneven surfaces and even parked vehicles [15].

Since the previous study only focuses on the issues towards the implementation of bike-sharing, thus, to fill up the gap of the study, this paper aims to look at the acceptance rate and the utilization factors of bike-sharing among Malaysian. The study will provide a framework that will help urban planners and practitioners to implement strategies to increase the attractiveness and usage of bike-sharing in Malaysia. It is eventually improved the sustainability of land use and public transportation systems. This paper also provides a knowledge base for future studies of bike-sharing in major cities of Malaysia.

## 2.2 Factors affecting bike-sharing utilization

Research was done by [21] identified availability as the number of bikes available, an appropriate docking station and effortless access. Undoubtedly, the docking station location was crucial to encourage individuals to practice a bike-sharing. The greater number of docking stations available, the higher the possibility of bike-sharing users. A number of studies have found that the bike-sharing programs must consider the socio-economically active areas which include accessibility to multimodal transport interchange hubs, commercial buildings, and universities to attract more customers [22-23].

In an investigation into bike-sharing activities, [24] found the numbers of injuries and fatalities retained raise due to lack of safety facet. This highlights the safety concerns associated with bike-sharing has been prominent at all times [25]. With the shortcoming studies on bike-sharing safety, there is an evidence to suggest that bicycle equipment (including helmets) and infrastructure have an

impact on bike-sharing safety. Safety concerns are the major blockade that hinders the bike-sharing activities [26]. Limited bicycle infrastructure and perceived risk of collision with motor vehicles named as a major safety concern [27]. In fact, due to the lack of a bicycle-friendly environment, the scheme would suffer from low participation rates. Thus, some of the facilities that required safety level advancement, including docking stations, bicycle lanes, paths, trails, and cycling network connectivity [28].

Convenience is often used in the context of transport, which is pertinent to demand. In relation to the bike-sharing, convenience is characterized as a vital factor for a long-term viability of the services through extended support and acceptability [29]. [6] concluded that convenience is one of the indispensable motivating factors in bike-sharing activities. A survey conducted by [30] have shown that bike-sharing services must be convenient not only for one user but rather for all the users. The users must be confident that they will not only find the bicycles at the intended location to start their trip but also will find a suitable place to leave them for others when their rides are completed.

The low cost of a bike-sharing program makes it rather a practical approach for everyday lives, act as a regular mode of transport and become as a motivating factor for individuals taking short trips [31, 27]. Predominantly, cycling is the fast, efficient and cost-effective mode of transport. In cycling-related research, the viewpoint of the benefits and values carry an imperative impact on an individual's decision to value the bike-sharing service [31]. In particular, several researchers found that bike-sharing users are cost-sensitive. For instance, [27] found that convenience and value for money are the key factors in bike-sharing. Likewise, [32] asserts that bike-sharing riders consider rate and efficiency as far-reaching determinants.

A recent study made by [32] determine bike-sharing programs have matured rapidly over the last twenty years around the world. Bike-sharing schemes becoming progressively prominent in the countries like Asia. Another study made by [33] also indicated that people use the service not only to commute but also for leisure, enjoyable social activity, sports and healthy as well as to show support for an environmentally friendly mode of transport. The same study found that increased bike-sharing usage is also attributed to the reduced rental costs which successfully stimulates demand of using the bike sharing service especially for price-sensitive consumers [33].

A large and growing body of literature has investigated that enjoyment is a leading reason for cycling. Furthermore, [34] and [35] denotes that

cycling enjoyment presents an excellent opportunity for people to integrate physical activity into daily life. Several studies have revealed that bike-sharing programs are a reciprocal positive role in promoting healthy weight [36]. Admittedly, cycling is a form of recreational physical activity which enhances well-being. The notion of cycling to maintain a healthy lifestyle can be used to promote the bike sharing usage. This is because cycling is an exercise and they are known to help prevent chronic ailments such as coronary heart disease [37]. This is important especially with the high number of heart failures reported in the Klang Valley [38].

### 3. Model Development

With the discussion presented in the previous section, this paper is intended to help fill this gap and, in particular, to provide a methodology for modelling the impact of bike sharing usage. Particularly, this paper aims to detail the main factors affecting the bike-sharing usage in Klang Valley. This research is adopting Theory of Routine Mode Choice Decisions (TRMCD) as a foundation to develop the research model. The first four variables of the TRMCD was selected based on the past literature argument namely availability, safety, convenience, cost, and enjoyment. Fig. 1 shows the factors affecting bike-sharing usage.

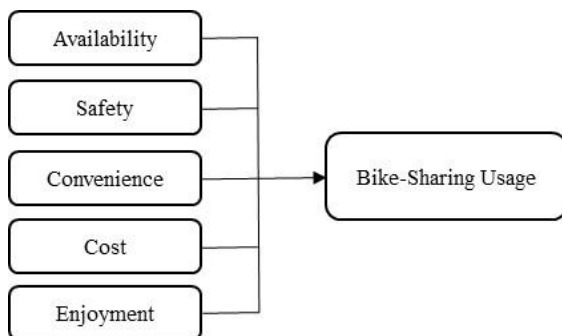


Figure 1: Research model

### 4. Methodology

Base Based on the existing literature and the construct to determine the major factors affecting the bike-sharing usage in Klang Valley, an online questionnaire survey was designed and implemented to collect bike-sharing usage in Klang Valley. An online survey was designed based on an extensive review of the literature and carried out among the public in Klang Valley. The survey inquired about their socio-demographic profile as well as their perception and acceptance level towards bike-sharing. Survey link also provided additional

information about the objectives of the study and the information about the researchers.

The confidence interval (CI) of 95% was chosen for this study as it is the most frequently used CI in practice. With the CI of 95% and the population of 1.73 million in Klang Valley, the minimum sample size required for this survey is 384. However, due to the low responses received we generated simulated data to represent user choice. Simulations use a mathematical model of the real response. This type of model use variables to represent key numerical measures of user responses to express the perceived selection of the real response. Simulations have been used and applied to models to predict outcomes of a research [39]. The simulated data was generated based on a uniform selection of a random element that simulates the answers to the potential questionnaire respondents. We limited the number of responses to 350 respondents. The uniform distribution is a square or rectangular distribution where the constant probability implies that every value from a certain range is of the same length on the distribution this has equal occurrence probability. Thus, for the data generated each simulated selection should have an equal chance of being chosen [40]. Based on the simulated response we present our findings of the simulation results in the following section.

### 5. Simulation Results

Our model measured each variable based on the simulated feedback generated. This is done using the following equation:

#### 5.1 Simulation Equation

$$\gamma = \alpha + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + \varepsilon$$

Where:

$\gamma$	Usage of Bike-Sharing
$\alpha$	Constant
$B_1$	Coefficient
$X_1$	Availability
$X_2$	Safety
$X_3$	Convenience
$X_4$	Cost
$X_5$	Enjoyment
$\varepsilon$	Estimated Error

Based on the simulation equation 1.1, five main independent variables were tested. However, only one significant variable was spotted convenience. Results are shown in Table 1 and Table 2.

**Table 1:** Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.110 <sup>c</sup>	.012	.003	.42326

c. Predictors: (Constant), Availability, Safety, Convenience

Table 1 shows the percent of the variability in the dependent variable that can be accounted for by all the predictors together (that's the interpretation of R-square). The change in R-square is a method to evaluate how much predictive power was added to the model by the addition of another variable. In this case, the percent of variability accounted for the usage of the bike went down from 0.2% to 0.1% as the predictors were added.

Table 2 shows that all predictors were statistically not significant except for one independent variable. The entire four models predicted scores on the dependent variable shows no statistically significant degree. The significant column for p-values, which need to be below .05 indicates a statistically significant result for the model for only one independent variable namely convenience. If the predictors had been statistically significant, these betas (B) are the weights that could be used by multiplying each person's scores on the independent variables, to obtain that individual's predicted score on the dependent variable (usage of bike-sharing).

**Table 2:** Coefficients

Model	Unstandardized Coefficients		Standardized Coefficient	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.276	.449		7.289	.000
Availability	.023	.072	.017	.317	.752
Safety	-.016	.077	-.011	-.213	.832
Convenience	-.099	.050	-.107	-2.002	.046
Cost	-.061	.056	-.058	-1.084	.279
Enjoyment	-.006	.041	-.008	-.157	.875

a. Dependent Variable: Usage

This model explains 1.2% of the dependent variable that usage of bike sharing was due to the availability of the independent variable (Convenience).

### 5.2 Final Equation

Final Regression shows the effect of the significant independent variable (Convenience) towards the dependent variable (Usage of Bike Sharing). The regression model developed was evaluated for two

extreme situations, i.e., all in good conditions and the worst conditions.

For all in good conditions, all attributes measured in the study were set as follows:

$$X_1 = 1 \text{ (Very Dissatisfied)}$$

$$\gamma = \alpha + B_3X_3 + \epsilon \quad (1.2)$$

$$\gamma = 3.586 + (-0.107)(1) + 0.449$$

$$\gamma = 3.586 + (-0.107) + 0.449$$

$$\gamma = 3.982$$

$$X_1 = 5 \text{ (Very Satisfied)}$$

$$\gamma = \alpha + B_3X_3 + \epsilon \quad (1.3)$$

$$\gamma = 3.586 + (-0.535) + 0.449$$

$$\gamma = 3.5$$

The results indicate that the respondent level of usage will decrease 4 times by the usage of bike-sharing when they felt the services of bike-sharing is not convenient for them. However, when they rate a higher level of satisfaction with the attributes of convenience, then the usage of bike sharing will increase by 3.5 times.

## 6. Discussion and Conclusion

This research investigated the factors affecting the usage of bike-sharing in Klang Valley. The results suggest that the variables in TRMCD model can be used to predict bike-sharing usage. Overall, only one determinant influencing bike-sharing usage. Convenience was the main factors positively contributed to bike-sharing usage in Klang Valley. This study offers several implications.

Even though bike-sharing is a relatively new concept in Malaysia, the usage is getting popular. From the result, it is identified that to get the Malaysian citizen to utilize the bike-sharing, the providers should take into consideration the convenience factors offered comprising spatial distance and mobile application's readiness as highlighted by [6].

This research has contributed to the existing literature by including different demographic variables to predict consumers' preferences towards bike-sharing acceptance in Klang Valley. The result shows similar findings with past research from the other county [29]. It has also answered calls from past researchers such as [40] who have suggested cross-country comparison studies.

To summarize, bike-sharing programs can help to increase accessibility to transit services in Kuala

Lumpur as an alternative sustainable transportation option for short trips. There is a need to encourage people to shift from automobile to cycling as an alternative transport mode. Bike-sharing program has significantly reduced air pollution and traffic congestion. The social and environmental benefits of bike-sharing rely heavily on the degree of modal shift from automobile to the actual use of bike-sharing. The findings from this study will help practitioners to implement strategies that have the greatest potential to increase the attractiveness of bike-sharing and improve the sustainability of land use and transportation systems.

## 7. Limitations and Future Studies

There are several limitations in this study. Firstly, the study is using simulation analysis due to low response rate. Future studies can extend this study to a wider group of sample size. Secondly, due to time and cost constraints, the convenience sampling technique was applied which led only limited number of Malaysian bike-sharing users at a specific geographical location participated in this study. Thus, future study should cover the whole Malaysian population located in populated areas and carry out a study at various geographical areas. Lastly, there is additional influencing factors have not been included in this model, such as awareness, security, and habit for example, and these can be included in future research models.

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