EXPLORATION OF PROSPECTS AND CHALLENGES OF RIDE SHARING IN DEVELOPING COUNTRIES: A CASE STUDY IN DHAKA CITY

MOHAMMED ANWAR UL ISLAM

M.Sc. ENGINEERING THESIS

DEPARTMENT OF CIVIL ENGINEERING
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY
DHAKA, BANGLADESH

JULY 2022

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A Thesis Submitted in Partial Fulfillment of the Requirements for the
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Exploration of Prospects and Challenges of Ride Sharing In Developing Countries: A Case Study In Dhaka City

CANDIDATE'S DECLARATION

It is hereby declared that except for the contents where specific references have been made to the work of others, the studies contained in this thesis are results of investigation carried out by the author under the supervision of Dr. Farzana Rahman, Professor Department of Civil Engineering, United International University (UIU), Dhaka.

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any other degree or diploma or others.

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Mohammed Anwar Ul Islam

Exploration of Prospects and Challenges of Ride Sharing In Developing Countries: A Case Study In Dhaka City

A Thesis

By

MOHAMMED ANWAR UL ISLAM

DEDICATION

Dedicated to my parents for supporting and
encouraging me to believe in myself

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With deep compassion, I hereby express fervent gratitude upon the Almighty's benevolent blessings, whose kindness was enough to allow me to achieve excellence and purity. A sincere pledge of appreciation toward Dr. Farzana Rahman, Professor Department of Civil Engineering, United International University (UIU), for her constant guidance and encouragement throughout the whole period of the thesis work. Her thoughtful guidance, constructive insights, and illustration of subtler ways to find a suitable approach on a demanding topic, including method of analysis immensely contributed to the improvement of this thesis paper.

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ABSTRACT

Public transportation largely contributes to the mobility needs of people which are increasing across the world due to rapid urbanization. Dhaka is Bangladesh's capital city and the country's economic center. Due to an increase in the number of motorized and non-motorized vehicles, roads in Dhaka are extremely congested. Ridesharing is a mode of transportation service that provides greater flexibility and availability on certain routes and is managed by private companies and individuals. Ridesharing is still a relatively new mode of transportation, and there is still a lot of room for growth. To remain competitive and influence customer behavior, service organizations must enhance service quality (SQ). Excellent service involves comprehension of customer feedback. SQ is the hypothetical consequence of a customer's anticipations and perceptions after obtaining service. The main objective of this study is to explore the prospects and challenges of ridesharing in developing countries.

A three-step methodology is employed for this research. A Questionnaire survey was conducted in the first step. Second step is interview survey to the operators and third step is data analysis and model development. The questionnaire survey was done to obtain information and users' perceptions about informal ridesharing, while an interview survey was done to gather operators' perceptions. Survey was done in 12 different locations of Dhaka city. The questionnaire had 27 variables all together. 700 questionnaires were distributed for the study. After checking the completeness 628 questionnaires were ultimately chosen for data analysis. The third step addresses SEM model development. Collected data was filtered and a few models were developed to comprehend the relationship between ridesharing service quality and other service-related variables. Goodness of fit were checked for each model by trial and error in respect of inserting different variables. Finally, the best model was selected from the developed models based on their fit-indices and resemblance with real life practices.

Among four of the developed models, M4 is selected as the best (CFI = 0.97, RMSEA = 0.082, SRMR = 0.068, AIC = 32512.92). M4 is constructed with four endogenous variables, ten exogenous variables and one latent variable. From results of M4, income , trip purpose, safety perception, preschedule trip, willingness to pay fare, and improvement in ridesharing influence SQ positively inferring that by improving those variables ridesharing SQ may be enriched. Among the variables comfort level, safety perception, and willingness to pay for ridesharing, have influence on ridesharing SQ.

The study findings can be utilized by the city transportation authority of Bangladesh to improve the overall ridesharing services to attract the new users as well as retain the current ones. If more opportunities can be provided in this sector, ride sharing will become one of the best options for the residents of Dhaka city.

LIST OF ABBREVIATIONS

BD	Bangladesh
BRTA	Bangladesh Road Transport Authority
CNG	Compressed Natural Gas
GPS	Global Positioning System
RHA	Ride Hailing Apps
SQ	Service Quality

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Public transportation largely contributes to the mobility needs of people which are increasing across the world due to rapid urbanization. Dhaka, the capital city of Bangladesh is one of the densely populated cities in the world having density of 122,700 people per square mile (Demographia, 2018). As a result, the transportation needs of Dhaka city is more than ever. The transportation system inside Dhaka city is primarily road based. Most of the daily trips in the city are accomplished by public transportation and non-motorized transportation system (NMT) or by paratransit as a considerable number of people do not have the financial ability to afford private cars (Rahman et al., 2017). Most of the people in developing cities depend on public transports, such as bus service due to its low travel cost (Rahman et al., 2017). Hence bus service plays a vital role in the overall transportation system. Although travel cost of public transportation is cheaper, it provides with less convenience compared to private vehicles. As owning a car gives the freedom to travel, not being limited to fixed routes and timetables, comfort and secure privacy as well as many other conveniences, people who have the financial ability to afford car are often encouraged to buy private vehicles for their personal transportation needs. On the other hand, private vehicles lead to more traffic congestion and environmental pollution as consuming huge amounts of fuel generating massive extent of greenhouse gas. Fossil fuel deficiency such as limited supplies of oil across the world, increasing prices of gas, traffic congestion and environmental concerns have recently increased the interest in services that acknowledges people to use private cars more sensibly (Agatz et al., 2012) such as sharing ride.

1.2 Shared Ride

Ride sharing (also car sharing, ride-sharing, lift-sharing or shared ride) is recognized as special transportation services with more flexibility and availability in selected routes operated by private companies and individuals. Ride share is the sharing of vehicles by

passengers to ensure the best use of occupancy of the cars for a particular trip. Ridesharing gives social and economic benefit for both drivers and passengers like saving travel time and cost. Ridesharing refers to a mode of transportation in which individual travelers share a vehicle for a trip by monetary payment (Ferguson, 1997). Ridesharing reduced the cost of private cars. Advantages of ridesharing for both drivers and passengers to society and to the environment include saving travel cost, reducing travel time, mitigating traffic congestions, conserving fuel, and reducing air pollution (Chaube et al., 2010). For the most part, ridesharing coordination is an informal activity and only in certain cases can travelers make use of ridesharing as a regular transportation alternative (Agatz et al., 2011).

The demand for ridesharing as a transportation service has increased rapidly in recent years having the goal to bring together commuters with similar routes and time schedules (Saranow, 2006). Ridesharing is advantageous to the society as it reduces congestion, greenhouse gas (GHG) emission and increased social equity. In a properly applied ride share scheme, drivers and passengers can save travel cost and time along with increased travel options. Ride sharing is not very popular transportation service in developing cities like Dhaka as it is not attained to a fully formal level yet. Generally, these vehicles are acknowledged as private car and micro bus. User demands and expectations for various service features can help authorities to implement specific development to the current state of that service. This research studies overall condition of ridesharing along with its opportunities and drawbacks that passengers are coming upon in Dhaka city based on their experience and perception.

In addition, ridesharing could contribute to important externalities, such as congestion and emissions. The impact on overall pollution is an empirical question because there are two countervailing factors (Nielsen et al., 2015). Lowering the cost of transportation is likely to increase vehicle miles travelled, which would increase emissions. However, encouraging higher capacity utilization rates could reduce emissions per vehicle mile travelled by an individual. Results suggest that overall greenhouse gas emissions could decline, but much

more research is needed on actual consumer behavior to develop conclusive estimates (Erdoğan e al., 2015).

1.3 Background of the Study

Dhaka is the capital city of Bangladesh as well as an economic hub of the country. At present, Dhaka city is experiencing severe traffic congestion for a higher number of motorized and non-motorized vehicles. Excessive traffic congestion and high demand of public transport become very hard to handle and traffic congestion becomes an unbearable daily life problem in the capital city. According to Bangladesh Road Transport Authority (BRTA), there are around 3.1 million registered vehicles in Bangladesh, and Dhaka has around one million of them. But different studies show that around 5 million vehicles, including the 3.1 million registered, are currently plying over the roads. The capital city Dhaka has become burdened in severe traffic congestion and mismanagement of traffic. The intolerable traffic congestion of Dhaka City has become an everyday certainty and a nightmare for the city dwellers. On the others hand for middle income families living in Dhaka; the even growing transportation costs put a considerable number of restraints on their budgets. For students and office goers, travelling in Dhaka city has become a painful experience. Local transports, such as CNG auto-rickshaws, buses and rickshaws fail to address the everyday transportation demand. Getting a public transportation has become a major problem for Dhaka city dwellers. To address this growing problem, ridesharing provides a more secure, cost-effective and easier way of travelling.

Users have a number of transportation modes options for their trips. They choose different transportation modes based on some utilities such as cost, travel time, reliability, flexibility (ability to adapt to changes in schedule), convenience (such as the location of the pick-up and drop-off points, the ability to listen to music, or privacy), and perception of security. To illustrate, first consider traditional systems such as buses to provide a travel option with a fixed geographic route with a fixed schedule, hereafter referred to as fixed-line systems (Agatz et al., 2012). These fixed-line systems charge a small fee to the traveler, but come with little convenience. Moreover, private cars or taxi services come at a higher cost, but

provide a more flexible and more convenient and often faster best choice (Beroldo, 2001). Ridesharing commuting is more popular for people who work in places with more jobs nearly and who live in places with higher residential densities. However, it is significantly less likely among people who spend more time at work, older workers, and homeowners (Klien, 2011).

1.4 Scope of the Study

An important characteristic of modern society is its concern with promoting viable alternatives of transport to replace the excessive use of the private car in most urban areas. Types of transportation that are considered shared ride. The intended benefits from increased ridesharing are substantial. Services provided by shared trips may not necessarily satisfy passenger's expectations fully. Ridesharing safety concerns relate to the well-being of passengers, drivers and service providers. A successful rideshare scheme could reduce costs for travelers and employers provide a reliable alternatives mode for travelers and promote greater equity transportation by employers, mainly lower income people.

Nowadays, the capital city Dhaka is clogged with severe traffic congestion for a higher number of private cars compared to its total road length. Ridesharing is the best in meeting the transport requirements. Thus, the objectives of this research are to explore of prospects and challenges of ridesharing in Dhaka city. As part of this study, the existing ridesharing services are assessed and challenges associated with ridesharing are identified and subsequently categorized. A Structural Equation Model would be developed to reveal uses perceptions of ridesharing to enhance the overall performance of the ridesharing services in Dhaka city.

1.5 Objectives of the Study

The main objective of this research is to explore the prospects and challenges of ridesharing in developing countries. The specific objective is to reveal user's perceptions of ridesharing for enhancing the overall performance of the services in Dhaka city by Structural Equation

Model.

1.6 Thesis Outline

The thesis contains five chapters.

Chapter 1:

Chapter 1 outlines the background of the study and objectives of Ridesharing. It also summarizes the outline of the entire thesis.

Chapter 2:

It presents a review of the previous study on ridesharing around the world, its problems and prospects. This chapter describes the present condition of Ridesharing in developing and developed countries. Additionally, this chapter discusses different forms of ridesharing.

Chapter 3:

This chapter presents the methodologies employed in this research. This chapter outlines the research approach used in this study, details of questionnaire survey, interview survey, details of data collection points and information about the software STATA.

Chapter 4:

This chapter provides the data analysis and model development using the survey data. It also outlines the model results and interpretation.

Chapter 5:

This chapter presents key findings from the respondents and SEM, challenges and mitigation measures of ridesharing along with prospects of ridesharing and recommendations for future studies.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Dhaka, the capital city of Bangladesh, is one of the most densely populated megacities where more than 105 million people live within an area of 1463.60 sq. km (World Bank, 2007). Traffic and transportation of the city is characterized by heavy congestion and delay, wide gap between transport demand and supply, poor traffic management, and poor public transport services. Inadequate public transportation system is one of the important causes for lack of suitable transportation management. The transport services currently provided in Dhaka city are unreliable, congested, insecure and unsafe for women. For short or long-distance trips, ride-sharing is the preferred mode of transportation. When it comes to the environmental issue, ridesharing may reduce emissions and vehicle ownership, enhance accessibility in places with inadequate public transit coverage, strengthen community relations and promote the welfare of low-income strata by lowering the quantity of automobiles on the road.

2.2 General Overview of Ridesharing

Ridesharing is defined as a type of transportation service that provides greater flexibility and availability on specific routes run by private companies and individuals. They move people using the same routes and schedules (Saranow, 2006). The ridesharing adoption as an alternative travel mode differs and still it is on low stage of participation. Ridesharing is a way to get the flexibility and speed of a personal car at a lower cost, while still getting the benefits of a car on a private trip (Chan and Shaheen, 2011; Ferguson, 1997). A ridesharing arrangement can be either familiarity-based or organization-based, depending on the relationship that a passenger has with the other participants in the ridesharing arrangement or on the passenger's capacity to use the service via an online platform (social media, or website).

Although ridesharing has been connected to a broad variety of social and environmental implications as well as a number of behavioral changes, further study is required since it is difficult for researchers to differentiate between different forms of ridesharing and record this information. Ridesharing minimizes personal automobile use and improves community uniformity. Travelers and drivers can save money and have more alternatives. Ridesharing reduces travel costs and comforts customers who can't afford a car (Chan and Shaheen, 2011).

The program has a specified timetable, departing point, and destination. The operator picks up and drops off passengers between journeys. Ridesharing reduces automobile mileage. Ridesharing reduces travel costs. (Agatz et al., 2011; Tao and Wu, 2008). It is environment friendly since it reduces CO_2 emissions. Caulfield (2009) stated ridesharing might cut CO_2 emissions. Ridesharing reduces fuel use and GHG emissions. It is predicted that employees who participate in a company-sponsored trip reduction program will lower their personal commute GHG emissions by 4% to 5%. Studies demonstrate that ridesharing programs help minimize VMT (VKT). Boarnet et al. (2014) found that these interventions can lower VMT by 4% to 6%. Ridesharing has been linked to decreasing VMT, yet reduced travel times and prices might lead to stimulated demand. It is predicted that employees who participate in a company-sponsored trip reduction program will lower their personal commute GHG emissions by 4% to 5% (Environmental Protection Agency, 2005).

While offering the same number of commuters with lower-cost express bus service, Dorinson et al., (2009) indicated that informal carpooling may significantly cut energy usage for 150 commuting passengers (Dorinson et al., 2009). Public and private sector employees can save capital costs of $15,000 to $45,000 per parking spot (depending on design and land availability) and operational costs of around $360 to $2,000 per parking space annually by lowering the number of car journeys (Shoup, 2011). Ridesharing has been found to have a significant impact in a variety of locations. Tao and Wu (2008) in Taipei showed that 70% of ridesharing users were women, while 90% of the overall participants were between ages 20 and 40. Users are willing to pay if they just have to wait 10 minutes and share the journey with three other people.

Most participants were delighted with ridesharing's rapid response, early arrival, and courteous drivers (Tao and Wu, 2008). The dangers include the exchange of personal information, such as travel plans and schedules, with unknown parties and by organizations (Chaube et al., 2010). Major drawback of ridesharing is the lack of privacy and security while sharing a vehicle with strangers. Other challenges include unwillingness to give up the comfort and convenience of a personal car and concern regarding ridesharing legal liability (Furuhata et. al., 2013).

The tech-based ridesharing services are more reliable than taxi based services because of lower costs and shorter wait times (Weng et al., 2017). These services have become more popular in recent years. Currently, 15% of adults in the US and 21% in major cities have utilized ridesharing (Clewlow and Mishra, 2017).

A comparison of app-based and traditional ridesharing was done by Chan and Shaheen (2011). Passenger's origin and destination were found to be the main difference between the two. Ridesharing services made it possible for many individuals to avoid purchasing a car. Tyrinopoulos and Aifadopoulou (2008) examined the relationship between Uber and urban traffic jams, focusing on the impact of Uber on on-demand app-based ridesharing services like Uber. Effectiveness may be improved by having a well-managed information system (Gheorghiu and Surugiu, 2016). By comparing taxi and ridesharing journeys, Rayle (2014) investigated how Uber consumers perceive on-demand ridesharing services. Recent years have seen an increased focus on the relationship between public transportation and ridesharing services. The debate continues over whether ridesharing is a replacement for or an addition to public transit (Hall et al., 2018). Ridesharing is a new and significant mode of travel in many cities all over the world, and the number of ridesharing companies continues to grow rapidly. When it comes to mass transportation, ridesharing can be a viable alternative to traditional modes of transportation.

2.3 Ridesharing Operator in Dhaka

Different app-based motorcycle/ car ridesharing services that are shown in Table 2.1. One of the most successful app-based ridesharing services in Bangladesh is Patho whilst UBER has the

most rapid growth in Dhaka. UBER is one of the fastest growing companies in the world and functioning in over 600 cities.

Table 2.1: Prominent app-based motorcycle/car ridesharing service providers in Dhaka city (BRTA,2000)

Indicators	UBER	Pathao	Shohoz
Year started	22 November 2016	2015	Mid of 2014
Service area	Dhaka and Chittagong	Dhaka, Chittagong, and Sylhet	Dhaka
Partner drivers	100,000+	50,000+	1,000+
Types of service	Uber X, Uber Moto, Uber Premium, Uber Hire	Ridesharing, Parcel, Food delivery, Merchant delivery	Bike Ride Only
Pricing for motorcycle service	Base fare Tk 30, Per km. fare Tk 12, Waiting charge Tk1/minute	Base fare Tk 25, Per km. fare Tk 12, Waiting charge Tk0.5/minute	Base fare Tk 25, Per km. fare Tk 12, Waiting charge Tk0.5/minute
Rider recruitment process	• Driving license • National identity card • Vehicle registration • Vehicle tax token • Vehicle insurance • Vehicle certificate of fitness	•Driving license • National identity card • Vehicle registration	• Driving license • National identity card • Vehicle registration

Ride-sharing services in Dhaka City were initially established in 2016 by the pioneering ride-sharing firms Pathao, Uber, and Amar Ride. Currently, some 125,000 motorcycles and vehicles are being used to provide ride-sharing services throughout the city. Motorbikes account for 104,389 of these, while vehicles account for 18,253, the majority of which are used as part of an informal ridesharing system. As a result, the city's accessible transportation has undergone substantial changes as a result of informal ride-sharing.

Decision making on informal ridesharing is influenced by factors such as fare discounts, greater travel time, and willingness to participate, (Alonso et al.,2020). It was shown that people are willing to deviate from their usual route in order to gain a discount on a fare. They found the willingness to share rides primarily depended on the time-cost trade-offs.

The “Ridesharing Service Guideline 2017” in Bangladesh allows commercial use of privately used vehicles via app-based services. The ridesharing services using motorcycle/cars are becoming popular among the app-based transport users as they can save time by reducing travel time in cities in the grip of traffic signals.

2.4 Informal Ridesharing in Dhaka

Ridesharing services which are not prescheduled, no fixed fare, no use of apps are known as informal ridesharing. Mentzer et al., (1995) focused on social and behavioral aspects of an informal ride sharing. Result shows that social interaction is relevant to mode choice; the more positive a social interaction is, the more people shift to an informal ride sharing, which is related to feelings of comfort and safety.

Informal ridesharing services that lack a functional platform or smart phone apps. It is common to see people matching rides at any junction in a metropolis and then handing over their fare in cash. Dhaka has a population of 17 million people crammed into an area of 1.528 square kilometers, making it the world's 7th most populous metropolis (Saadat et al, 2018). It is difficult to get around the poorly managed and controlled public transportation system in Dhaka city. Every year, almost 37,000 automobiles join the city's roadways. About 80% of those are personal vehicles.

2.5 Service Quality

Service organizations must improve service quality to remain competitive and promote client behavior (Kotler & Keller, 2006; Lovelock & Wirtz, 2007). Excellent service requires understanding client feedback. SQ (service quality) is the hypothetical consequence of a customer's expectations and views after receiving service (Fecikova, 2004). SQ promotes repeat purchases (Cronin and Taylor, 1992). Keeping customers pleased means more new and fewer lost customers (Parasuraman et al., 1987). SQ should be assessed by passengers' service views to establish a proper feedback system. To get a competitive edge and deliver a better service, it is necessary to analyze performance of a service.

SQ is the discrepancy between customer expectations and observed service, according to Beerli et al. (2004) and Parasuraman et al. (1985). Public satisfaction is the feeling of fulfillment they have after receiving a product or service (Oliver, 1997). User satisfaction, as defined by Lin et al. (2010), is the degree to which a client is happy with the service supplied relative to their expectations. Cronin and Taylor (1992) said that customer satisfaction is a prerequisite for service quality, while Stevens et al. (1995) suggest that consumer satisfaction is a determinant of service quality. Customers are satisfied when the quality of service they receive exceeds their expectations. It is believed that SQ and customer satisfaction are distinct but closely related concepts. According to Beerli et al. (2004), the two notions are inexorably intertwined. Enhancing customer satisfaction will increase sales and market share (Mentzer et al., 1995). A failure to comprehend client demands may result in subpar service attempts.

Different methodologies were used to compare users observed SQ characteristics. The most common tools are user surveys, interviews, and focus group consultations. Several studies on mass transit user satisfaction (Cunningham et al., 2004; Hu and Jen, 2006; Tyrinopoulos and Aifadopoulou, 2008) have employed different analytical tools, such as regression analysis (e.g., Kim et al., 2011). Factor analysis was utilized by Agarwal (2008) to identify the most critical variables that impact the satisfaction of train service users. The manner of the workers had the largest influence on passengers' satisfaction with Indian railway services, out of all the variables studied.

SEM is often used in SQ analysis and to explore user perception. Several research (Rahman et al., 2016; Ratanavaraha et al., 2016 and Andreassen, 1995) used SEM to define public transport consumers' perceptions. Andreassen (1995) compared public and private services and found that customer preferences for public services are comparable yet diverse. Hall et al. (2018) analyzed the SQ of New York city public transportation using a SEM model. Some variables affect satisfaction directly, while others affect as intermediary variables. This research examined present and prospective consumer expectations, improvement objectives, and limits. Eboli and Mazzulla (2007) used SEM to study bus service aspects and user satisfaction. Service design and dependability impact customer happiness the most.

SEM has a number of benefits over other regression methods. First and foremost, the SEM model allows for the estimation of all coefficients at once, making it easy to evaluate the model's relevance and strength. The second advantage of SEM is that it can handle ordered regression (Hall et al., 2018). A variety of visible and unobserved restrictions appear to have a role in influencing a person's choosing behavior.

In emerging cities like Dhaka, there is a discrepancy between the quality of service and the level of customer happiness. This study tries to find out what influences the ridesharing services quality of Dhaka, Bangladesh.

2.6 Previous Study on Ridesharing

Saranow (2006) described that the demand for ridesharing as a transportation service has increased rapidly in recent years having the goal to bring together commuters with similar routes and time schedules. Several studies assessed the impacts of ridesharing apps or ride-hailing apps (RHAs) on traditional transport services but a few investigated the adoption and utilization of RHAs. For example, Clewlow and Mishra (2017) examined the differences between users and non-users of RHAs in major USA cities. Based on fundamental descriptive statistics, the authors found that 21% of adults personally used RHAs; an additional 9% used RHAs with friends but have not installed RHAs themselves. They also found that college-educated and affluent Americans have adopted RHAs at double the rate of less educated and lower income populations.

App-based ride services have some important effect on ridesharing. Wadud (2020) explained the impact of app-based ride services on motorcycle ownership in Dhaka city. This research stated that income per capita has a statistically significant effect on the increase in motorcycle ownership in Dhaka.

There are different models to analysis the impact of ridesharing. Kim et al. (2011) discussed the hybrid choice modeling approach for motorcycle based ride-hailing services. The study includes 19 variables and applies a hybrid choice model by employing 703 bus passenger responses in

Yogyakarta, Indonesia. The analysis shows three latent variables (forced bus use, bus service quality, and favorable conditions for bus use) that most significantly impact the selection of bus service over motorcycle-based ride services.

Some attributes affect the decision of carsharing. Morency (2007) surveyed Blabla car users in France to study which attributes affect the decision of carsharing as a driver or passenger. By using a state preferences survey, he estimated the value of travel time of drivers and passengers and compared these values against other transport modes. Ghoseiri (2009) analyzed the shared rides from Blabla car in the case of Spain. Trip distribution was characterized by aggregating four months trip data by the autonomous regions in Spain. The results showed that shared trips were mainly used for middle distance trips at a regional level since a significant number of trips connect secondary provinces with regional centers and the capital.

Further, Lin et al., (2010) investigated behavioral adoption of RHAs in Malaysia, using multiple linear regressions. These studies were based on subjective responses to examine the causal relationship between behavioral adoption and other latent variables, including perceived usefulness, subjective norm, and perceived playfulness of RHAs. Clewlow and Mishra (2017) explained that the advent of RHAs have created significant debates in many cities worldwide on various issues, including how RHAs should be regulated, their safety implications, and how they influence travel behavior.

Due to a lack of vehicles, ride-hailing companies may be compelled to boost the amount of money they make by subsidizing rides. Furuhata et al., (2013) modeled a ride-hailing platform and analyzed the effects of pricing and subsidies on social welfare. Using a gaming approach, they modeled a platform of renters and owners in a platform applying static pricing settings. They found that there is a trade-off between revenue and social welfare maximization.

Peripheral communities were unable to take advantage of ride-sharing since there was not enough of a population of drivers. Boarnet et al., (2014) analyzed the spatial distribution of intercity ridesharing in Hungary. In addition, sharing practices were characterized by surveying

ridesharing users. They found a correlation between relative population size and number of travelers. Ridesharing was found popular in regions with a big gap between public transportation and motorways accessibility.

The primary obstacles to the success of carpooling are a lack of flexibility and psychological barriers, such as the establishment of a sense of dependency and mistrust between partners. Lauren and Gonzalez (2014) identified the main perceived risks by carpooling users into relational, organizational, security-oriented and car-oriented risks. They listed the common strategies for users to mitigate relational risks during the different stages of the ride-sharing process by considering their lived-experiences.

Compensation for commuters who make the trip and penalties for those who do not have the ideal motivation without compromising societal well-being. Shoup (2011) investigated ridesharing strategies that encourage commuters to disclose their travel preferences and the likelihood that they will take the trip. In their view, it was a flawed system in which private information was not accessible to all users.

Research conducted in Taipei city by Tao & Wu (2008) showed that approximately 70% of the ridesharing participants were women and about 90% of the total participants‟ age was within 20 to 40 years as young office going women were the maximum portion of the participants. Morency (2007) explained that ridesharing is a mode of transportation (carpooling or van pooling) in which individual travelers share a vehicle to reach a destination as long as it has the same travel plan and time schedule. It has been suggested that ridesharing is a feasible alternative of conventional modes of transportation.

Instead of making a direct investment, they looked at incentives tied to the employer and parking preference incentives. When it comes to carpooling incentive schemes, Seo et al.,(2017) developed a mechanism for anticipating changes in short-range travel patterns (including carpooling). Using a multinomial logit probabilistic choice model, they applied disaggregated travel demand models.

2.7 Ridesharing in Developing Countries of Asia

The transportation sector is a significant user of energy. Encouragement of ridesharing is one known strategy for reducing traffic that some suggest is second only to a driving ban in its potential for reducing energy use in developing countries. Some ridesharing practices in developing countries is given below.

2.7.1 Ridesharing in India

In India, there are numerous mobile applications for ride sharing. Ola Share, Bla Bla Car (Inter-city), ORahi (NCR), Ibibo Ryde, Zify, Pool Circle in Hyderabad, LiftO in Mumbai, and Pikup in Gurgaon/NCR are some of the most popular ridesharing services in India (Manzini et al, 2011). It is common practice in India to employ a carpool (also known as a rideshare, car-sharing, or lift-sharing) for commuting.

2.7.2 Ridesharing in Pakistan

To reduce traffic and carbon emissions in Pakistan, dynamic ridesharing provides a chance for a flexible and economical service that utilizes vehicle seating space. A dynamic ridesharing system that matches trips and requests in real time and satisfies travelers is a laborious process, but it is necessary to match the needs of all passengers. In Pakistan, a new dynamic ride matching system based on GPS (global positioning system) is being proposed to efficiently match ride givers and riders.

There are more than a hundred and thirty million mobile phone subscriptions in Pakistan, but only twenty one percent of the population subscribes to an internet package. This means that the car-sharing service has to deal with a lot of technical difficulties because the service relies solely on internet connection (Deakin et al, 2010).

2.7.3 Ridesharing in Sri Lanka

Connecting people who need to travel with car owners who have spare seats is the goal of BlaBla Car in Sri Lanka. If you need a ride, discover a dependable car owner and save money on

transportation, even if you wait until the last minute. If a driver has spare seats, offer to share the expense of a ride with a group of trusted companions. Colombo hosted Uber's official launch in 2012, following a period of increasing demand for the ride-sharing service in the country. As the largest taxi service in the world, Uber does not own any vehicles and instead relies on a rideshare model in which individuals who own vehicles and are willing to provide transportation services can sign up with the firm. Uber is a service that links cab drivers with those who need a trip. When a customer presses the Uber request button, the business promises that a taxi will arrive within five minutes. Only in Colombo City, selected areas, and a stretch to the Katunayake Airport are pickups and drops accessible. Uber forecasts tremendous growth in Sri Lanka, backed by 1 million credit cards, 11 million debit cards, and a 20% usage of smart phones (Lauren et al., 2014).

2.7.4 Ridesharing in China

A growing middle class and increasing income have helped China become the world's most populous car market. The significant rise in Chinese car ownership in the 2000s was a result of China's economic prosperity. In the last five years, sales of new cars in China have decreased year over year due to the country's recent economic recession. To combat air pollution and traffic congestion, many major Chinese cities have taken efforts to reduce their population of private automobiles by increasing public transportation options. Ridesharing services have exploded on the scene to assist reduce the number of automobiles in Chinese cities and also address the rising demand for personal mobility by the middle class. Ridesharing is one of the most rapidly expanding modes of transportation in the world, and it has already taken root in many Chinese cities. Some of China's 240 million vehicles and congested roads have attracted many ride-sharing startups in the previous five years.

2.7.5 Ridesharing in Thailand

People in Thailand have the ability to move from place A to point B speedily, safely, and dependably by using an application on their smartphone. Uber has made it possible for more people to fit into a reduced number of vehicles, which has the effect of lessening the amount of traffic congestion. Since traffic is an issue in Bangkok and Chiang Mai, this will be of assistance

in both cities. We have harnessed the power of emerging technologies to ensure our customers' safety from the moment they step foot inside an Uber vehicle until they arrive at their final destination. This protection extends from the moment they step foot inside an Uber vehicle until they arrive at their final destination. Every trip is monitored by Uber's GPS, and our two-way feedback function enables riders to instantaneously share trip data and estimated arrival times with the people who are important to them. Uber is used extensively all over the world since it is a means of transportation that is not only secure but also efficient and saves time. According to the information provided on the Uber website, people from more than seventy-four different nations have used Uber in Thailand.

2.7.6 Ridesharing in Malaysia

In just a few short years, Malaysians have seen the importance of owning a car diminish significantly. This is mostly because of the rapid development of ride-hailing services like Uber, Grab, and airport2u in Malaysia, which, like so many other things, has benefited from the incredible growth of technology.

2.8 Ridesharing in Developed Countries

2.8.1 Ridesharing in UK

For the carpooling app. Carma, the software automatically pays the driver when the trip is over based on the distance traveled (Heinrich, 2010). With Sidecar, clients would always know exactly how much their trip would cost in advance. There are a range of cars to choose from in the area depending on information such as distance, quality of a vehicle, fare and rider ratings, and any other bio information that the driver has included in their profile. As an additional option, passengers can choose to have their chosen drivers show up at the top of their options list whenever they're looking for a ride and the driver is both nearby and available (Heinrich, 2010).

2.8.2 Ridesharing in Europe

It is hoped that services like Uber and Airbnb would lead to a significant increase in productivity as a result of the more effective use of current resources and a significant reduction in regulatory overheads. In Europe, these services are quickly reshaping established markets. Automobile

sharing programs like carpooling or ride sharing fall under the umbrella term "Shared car usage," which encompasses a broad range of social practices. Each initiative has its own unique focus, but at their core, they all aim to reduce transportation costs by sharing a vehicle.

2.9 Benefit of Rideshare in Developing and Developed countries

The use of shared transportation has been proved in several cities to support car-light lifestyles. Research conducted in London, for example, indicated that 31% of car-share users rejected to buy a car they otherwise would have bought, whereas 6% of car owners planned to or had previously disposed of a vehicle as ridesharing was available there (BCG, 2017).

Benefit 1: More Passengers per Vehicle

A key way ridesharing can reduce congestion is via increased vehicle occupancy. This benefit was demonstrated in Jakarta where, in 1992, the government introduced a policy that required vehicles to carry at least three occupants when travelling on main routes during peak hours (3-in-1 policy) (Beroldo, 2001). A recent study by researchers at Harvard and MIT universities found that following the repeal of this policy, morning and evening congestion on the newly-liberalized routes leaped by a staggering 46% and 87%, respectively (Lauren et al, 2014).

Benefit 2: Complementing Public Transport to Accelerate Adoption

Studies have also shown that in addition to reducing car ownership, shared mobility users are more likely to increase their use of public transport. A study published by the National Academy of Sciences, which covered several major US cities, found that 43% of shared-mobility users reported an increase in their use of public transport, while only 28% of individuals reported using public transport less (Lauren et al, 2014).

Benefit 3: Greater Vehicle Utilization per Kilometer

A common challenge in cities is matching transport supply with demand to ensure sufficient supply during peak times, but reducing supply during off-peak time, to minimize KM travelled without passengers (Lauren et al., 2014).

Benefit 4: Ridesharing Substituting against Private Vehicles

Ridesharing benefits are obtained by providing greater transport efficiency (people-kilometres) compared to private vehicles. However, to provide net positive benefits for congestion, cities must ensure substitution of ridesharing for private vehicles (private cars or motorcycles) and not public transport (Parkin et al, 2008).

2.10 Ridesharing in Other Form

Slugging

Slugging, also known as casual carpooling, is the practice of forming informal carpools for purposes of commuting, essentially a variation of ride-share commuting and hitchhiking. Typically slugging is motivated by an incentive such as a faster HOV lane or a toll reduction. While the practice is most common and most publicized in the congested Washington, D.C. metropolitan area, slugging also occurs in San Francisco, Houston, and other cities (Ghoseiri et al, 2011).

Flexible Carpooling

Instead of arranging ahead of time for carpooling, flexible carpooling uses defined meeting points. It aims to duplicate the informal "slug-lines" that develop in Washington DC, Houston, and San Francisco by creating more formal venues where people can organize carpools without prior interaction. Without any prior communication between participants, the systems use a meeting spot to arrange carpools. Carpooling is much easier when you just show up at a predetermined location and wait for other individuals who want to join you, rather than having to find other people and coordinate a trip in advance. Carpooling is only possible if there are enough people coming to the meeting point and if enough people are going to the common destination that there is no unreasonable wait time. As part of Marin County's carpooling

program from 1979 to 1980, significant crossroads near bus stops were used as meeting sites. As part of a pilot program in the Seattle corridor, the Washington State Legislature began carpooling in 2009 as a way to assess the viability of this mode of transportation for legislators (Herbawi et al, 2011). The smartphone ride matching system will be a part of this.

Real-time Ridesharing

Real-time ridesharing (also called instant, dynamic, ad-hoc, on-demand, and dynamic carpooling) arranges one-time shared rides on short notice. This carpooling uses three new technologies. (1) GPS devices to plan a driver's route and shared journey. (2) Smartphones to request a ride anywhere. (3) Social networks for driver-passenger trust and responsibility. A network service handles driver fees and matches trips using an optimization algorithm. Real-time ridesharing is advertised as a way to better use empty seats in passenger automobiles, reducing fuel use and transport expenses. It can serve non-public transit areas as a feeder service. Ridesharing can serve both recurring and one-time excursions. In the early 2010s, various TNCs were presented as ridesharing but dispatched taxi-like commercial operators. First to market was San Francisco's Sidecar (Lauren et al, 2014). Experts call these services "ride sourcing" to explain that drivers don't share a destination with customers; the app outsources rides to commercial drivers.

Car Clubs and Car Sharing

For brief periods of time, people can rent cars by the hour through car sharing or car clubs (in the UK). This form of car is ideal for clients who only use their vehicle on occasion. It also attracts those who would want to have occasional access to vehicles of various types than they often use in their daily lives. Companies, public agencies, cooperatives, and other non-formal organizations can all borrow automobiles through car-sharing services. In more than a thousand places across the globe, car-sharing services are accessible. According to the Transportation Sustainability Research Center at U.C. Berkeley, there were approximately 1.7 million car-sharing members in 27 countries as of December 2012. This includes so-called peer-to-peer services.

Hitchhiking

Hitchhiking involves asking strangers for a ride in their car or other vehicle. Generally, rides are free. Itinerants have embraced hitchhiking as a primary way of travel for most of the last century (Winter et al., 2006). Hitchhikers use a variety of signaling techniques to let vehicles know they want a ride. Hitchhikers frequently communicate with one another by use of a variety of hand signals. A physical gesture or a written sign might be used by the hitchhiker to communicate his or her need for a ride (Leblanc, 1999). Gesturing with one's thumb pointing upward with one's hand closed, as in North America, Europe, and the United Kingdom, is common in these regions. The thumbs up sign is common in the United States and the United Kingdom, for example. The palm of the hand should be facing upwards in various African countries. The index finger is commonly directed at the road in different regions of the world (Frisk al el., 2010).

Peer-to-Peer Car Sharing

Short-term rentals are possible through Peer to peer car sharing, which allows owners to make their automobiles available to others. Among the most popular methods of taking part in the sharing economy is by lending a car to a friend or member of your family. However, the "virtual" fleet is made up of automobiles owned by participants, unlike real car clubs like the Streetcar or Zip Car. Peer-to-peer car sharing allows participating car owners to charge a fee for renting out their vehicles while they are not in use. Anyone who participates in the initiative will have access to local and reasonably priced vehicles. To utilize it, users just pay for the amount of time they spend doing so. Many of these companies conduct background checks on tenants and landlords before providing them with a website or mobile app that allows the booking and collection of rent. All of a company's expenses, including insurance for the borrower or tenant and operating costs like towing, are deducted from its gross revenue (Kamar et al., 2009). It has been made possible by the internet and the emergence of geo-location-based services, just as they have been for person-to-person loans (Gerding et al., 2011).

Casual Carpooling

There have been several articles on casual carpooling, also called slugging, in Houston, San Francisco, and the Northern Virginia/Metro Washington D.C. areas. They tangentially discuss

transit's intersection with casual carpooling, instead focusing on how specific systems work or how passengers behave (Bhattacharyya, 1995). On the other hand, he suggests that casual carpooling could be encouraged if it reduces demand on transit service along a particular corridor, thereby allowing transit service to be increased along other corridors, which might attract new riders and take cars off the road (Levofsky et al., 2001). The article also provides insight into the effects of casual carpooling on transit agencies, citing several problems reported by BART and AC Transit (Alameda–Contra Costa Transit). These problems include a decline in public transit ridership and revenue and a lack of parking available for round-trip transit patrons. In response, the transit agencies have made changes to their operations, although attempts to control or discourage casual carpooling have been largely ineffective (Chaube et al., 2010). A survey conducted in 2010 by 511 Rideshare reported that 47.3% of casual carpoolers indicated they previously commuted by BART or AC Transit before they started casual carpooling.

Dynamic Ridesharing

Dynamic ridesharing is the web or an automated telephone system, riders requested rides minutes before leaving home. It is call a dynamic system because the users can find ridesharing partner(s) at any time, even shortly before making a trip.

CHAPTER 3
METHODOLOGY

3.1 Introduction

This chapter represents the research approach used in this study. Details of data collection methods for interview survey and questionnaire survey for obtaining users and operators views on informal ridesharing are described in this chapter. This chapter includes some general information about the statistical software employed for model development.

3.2 Research Method

A three-step methodology is employed for this research. A Questionnaire survey was conducted in the first step. Second step is interview survey to the operators and third step is data analysis and model development. A questionnaire survey was done to obtain information and users' perceptions about informal ridesharing, while an interview survey was done to gather operators' perceptions. Survey was done in 12 different locations of Dhaka city. The questionnaire had 27 variables all together. 700 questionnaires were distributed for the study. After checking the completeness 628 questionnaires were ultimately chosen for data analysis.

The third step addresses SEM model development. Collected data was filtered and a few models were developed to comprehend the relationship between ridesharing service quality and other service-related variables. Goodness of fit were checked for each model by trial and error in respect of inserting different variables. Finally, the best model was selected from the developed models based on their fit-indices and resemblance with real life practices.

3.3 Data Collection Method

3.3.1 Questionnaire Survey

The following is a brief description of each of the questionnaire's sub-heads:

Demography

This section includes questions regarding the respondent's gender, age, education qualification, occupation, as well as their income level and whether or not they possess a vehicle, all of which

are extremely crucial because they influence whether or not they require ridesharing. If they didn't have a car of their own, it was questioned to them about how they felt about the prospect of traveling with a group of strangers in someone else's automobile. If they did have a car of their own, then questioned how they would feel about the reaction of traveling with strangers in someone else's car.

Characteristics of the Trip

In this section of the questionnaire, the respondents are asked about the total travel expenses for the month, their typical travel schedule, the location that is most frequently visited by them from home, and the goal of their journey. The distance from their starting point to their final destination was then carefully estimated, and they were questioned regarding the primary mode of transportation they used. The cost of using a bus, tempo, or taxi is quite modest, however the fare for an auto rickshaw is quite expensive. It should come as no surprise that those who traveled by private automobile incurred a higher total cost for their journeys than the rest did.

Rideshare Service

This section of the survey was intended to obtain feedback on respondents' attitudes toward informal ridesharing. Ten to twenty minutes was the average waiting time for getting a public transportation. Despite the fact that the trip had been planned in advance, they were unable to secure a vehicle in time. If ridesharing is accessible in Dhaka, how much would people be willing to pay for it: A typical response was between 100 and 150 taka. The responders are asked in the final question of this section, the reason of considering the ridesharing services.

Safety /Comfort

Ridesharing services have a major problem in terms of safety. They are asked about their safety issues they felt during the ridesharing with the strangers. As the means of transportation, the driver must travel quite a distance to pick up their passengers, ridesharing has the worry of not being in a defined time frame. As a result, the driver must take an additional route to pick up another passenger after picking up the first.

Service Quality

In this section, questions were asked about rideshare service quality and limitations, and a choice was provided for satisfactory, good, or exceptional service.

Improvement

The final section of the survey inquired about potential ways to improve in context of the limitations that were identified. It was critical to convey the questionnaire's purpose and the city of Dhaka's impact on ridesharing quality during a thorough discussion of the plan. The primary purpose of this questionnaire survey was to gather feedback on the proposed ridesharing program and to ensure that participants received accurate and complete information.

The questionnaire took roughly 10 minutes to complete in total. To ensure that the participants understood what was being said, the surveyors were careful to be as specific as possible. All the answers were checked off as they were presented after the explanation of the entire scheme. An excel spreadsheet was used to compile the information gathered from the various sites.

Using STATA to model the Service Quality of Rideshare in Dhaka City, the missing data was filled in and the inputs were verified as legitimate. Fig 3.1. depicts the surveyors during interviewing the participants.

Fig 3.1: Surveyors collecting data with questionnaires

3.3.2 Interview Survey

Interviews were done with the drivers to get a sense of how they treat passengers, as well as the difficulties they have while travelling with the police and those in their cars. During a 20-person interview, a few questions were asked. They kept the interview brief since they are so busy with ridesharing that responses could be obtained quickly. A spreadsheet in Excel was used to compile all of the data from the different sites.

3.4 Data Collection Point

The data collection point consists of a few specific corridors that have been picked from the city of Dhaka. Over 15 million people live in Dhaka city, giving it a population density of 8229 people per square kilometer, and it serves as the political, cultural, and economic capital of Bangladesh (CHALO, 2017). The road networks of Dhaka are close to 3000 kilometers, with 200 kilometers of primary roads, 110 kilometers of secondary roads, and 50 kilometers of feeder roads. The remaining 2640 kilometers are comprised of tiny roads with few options and connection roads (World Bank, 2007)

.

3.5 Details of the Data Collection Point

Following locations were selected for data collection : Kazi Nazrul Islam Avenue Sarani, Captain Mansur Ali Avenue, Shaheed Tajuddin Ahmed Avenue, DIT road, New Market Thana Road, Rampura Thana Road, Panthapath, Shahbag, Paltan Thana, portion of Badda Thana, and Gulshan 2 circle area. The survey was conducted at peak hours to find enough participants. Eleven places were surveyed. Informal ridesharing was observed at Dhanmondi 7 no, New market (opposite 2nd gate), Motijheel (Shaapla Chattar), Shainik Club Morr, Kakolir Morr, Mirpur 10, Kochukhet, Kalshi, Notunbaazar, Badda, Gulshan 2. Figure below shows data collection points in Dhaka (Google Map).

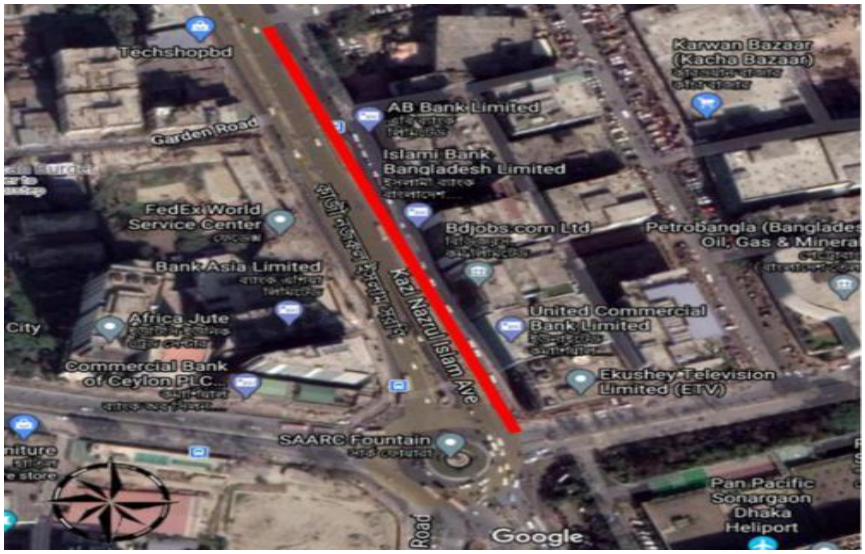


Fig 3.2: Kazi Nazrul Islam Avenue Sarani

Fig 3.3: Shaheed Mansur Ali Soronee

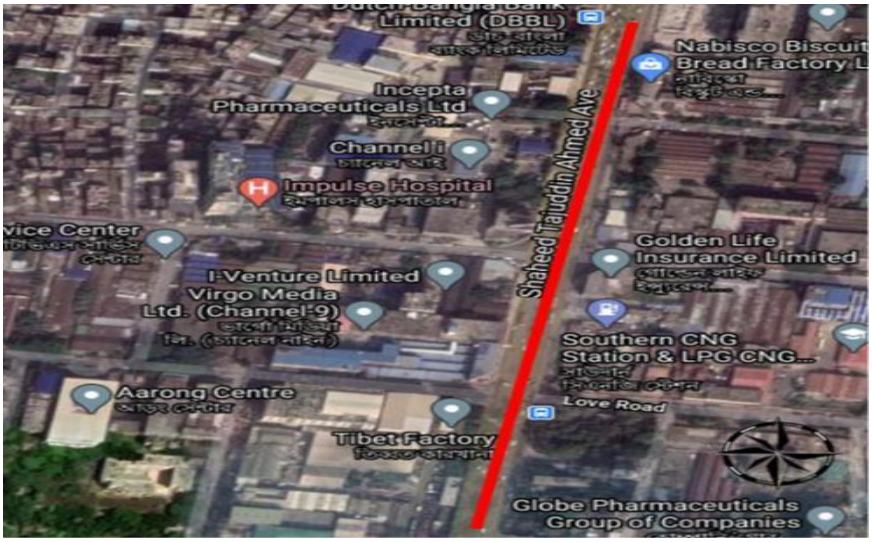


Fig 3.4: Shaheed Tajuddin Ahmed Avenue

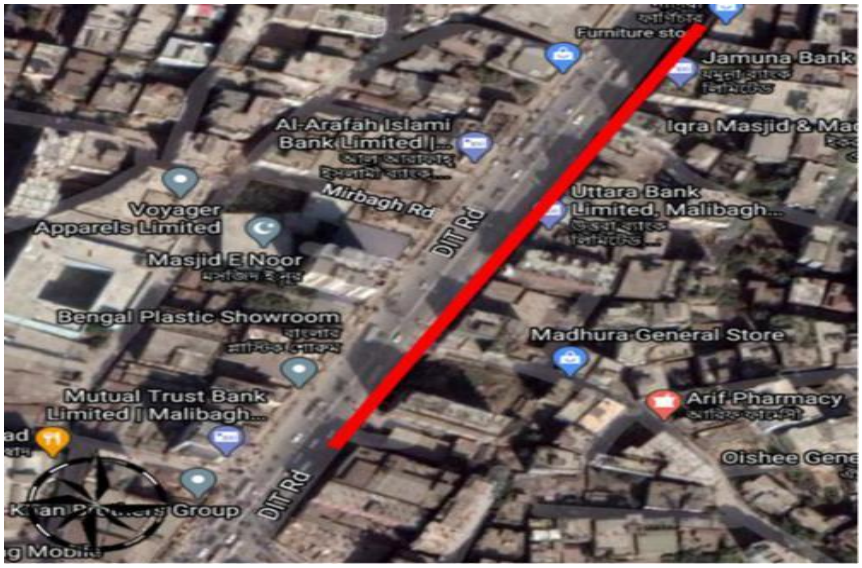


Fig 3.5: DIT road

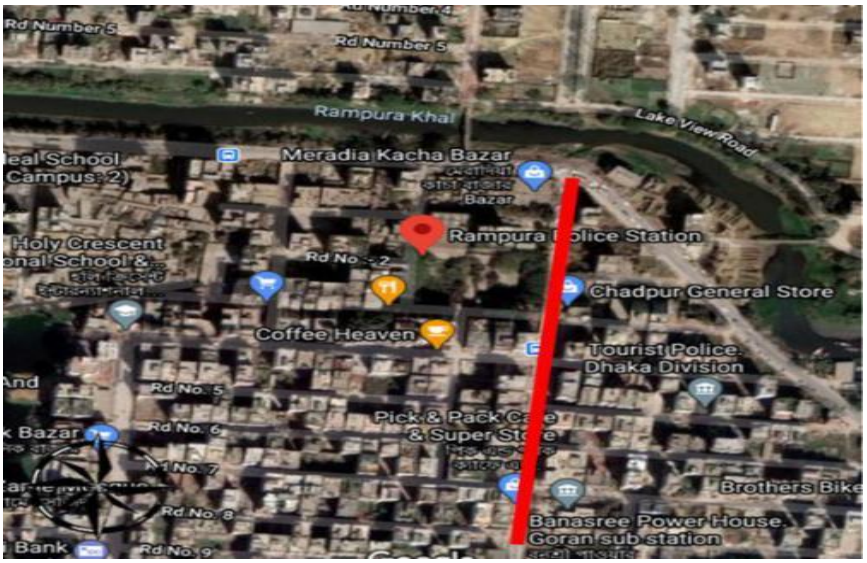


Fig 3.6: Rampura Thana Road

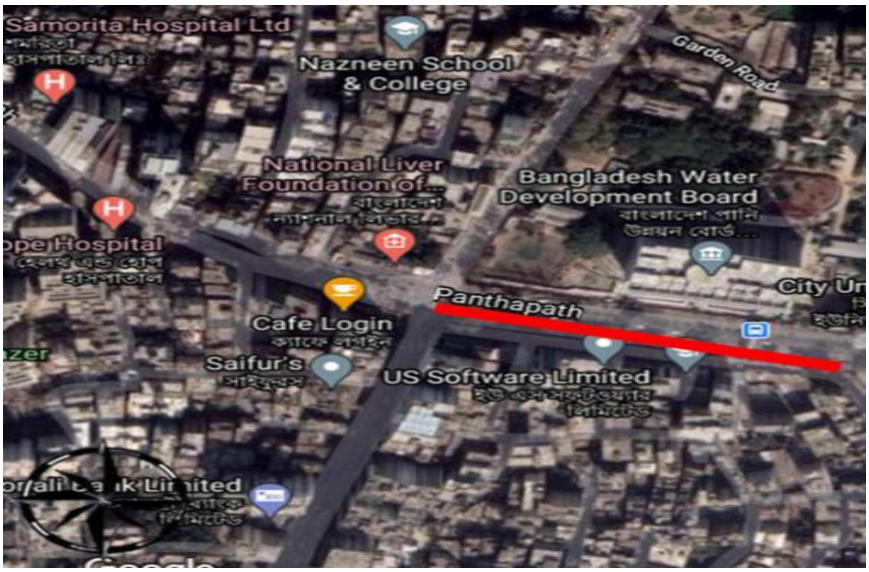


Fig 3.7: Panthapath

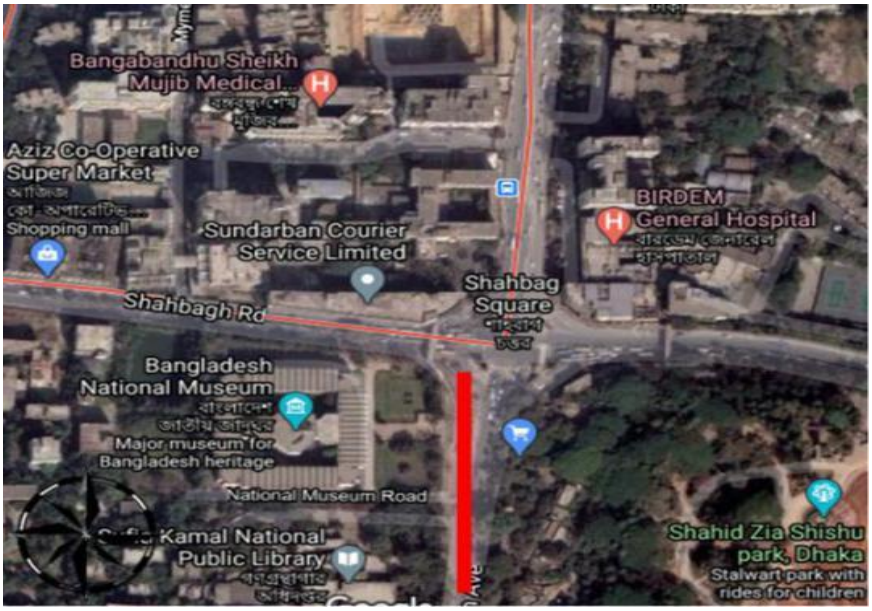


Fig 3.8: Shahbag

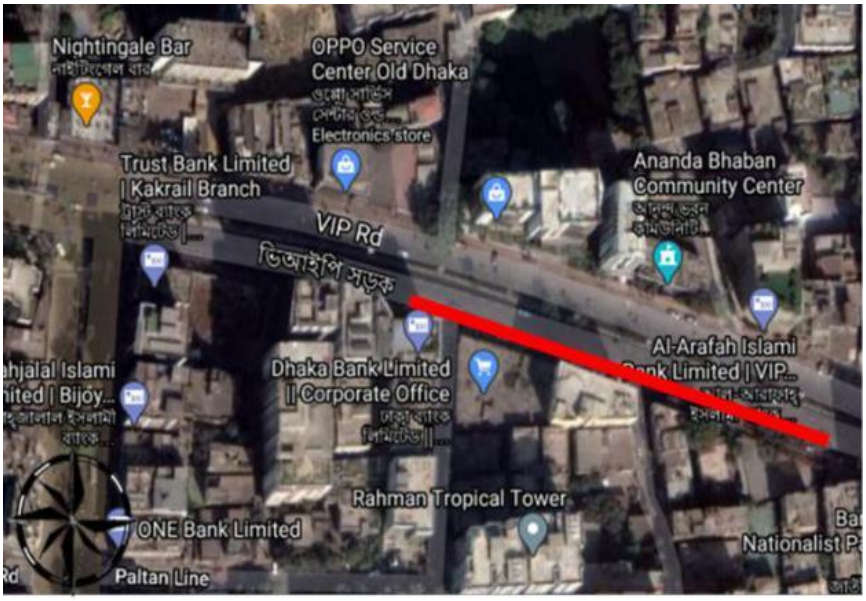


Fig 3.9: Paltan Thana Area

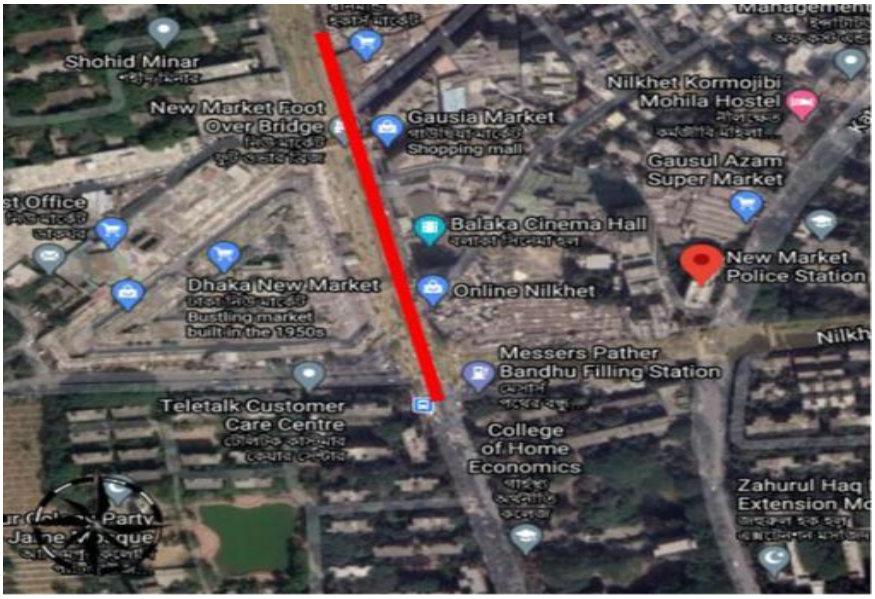


Fig 3.10: New Market Thana Road

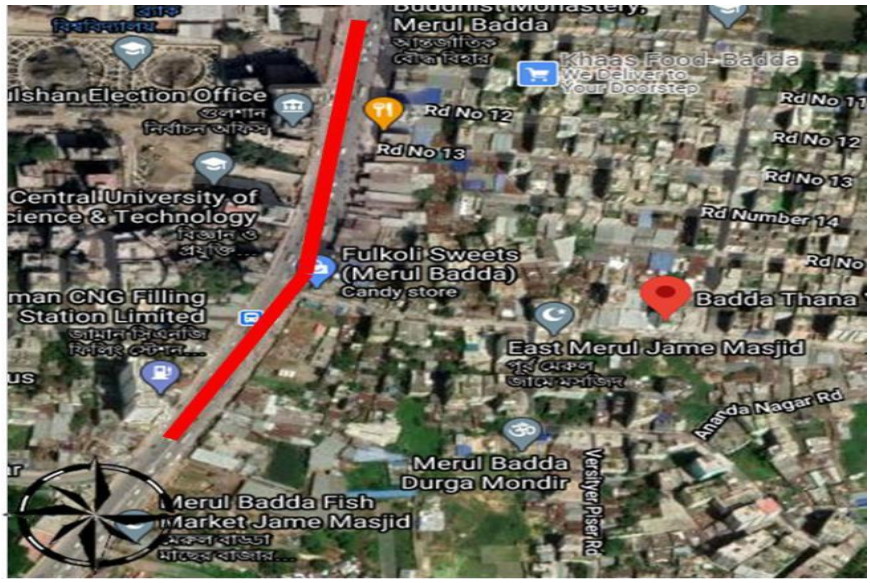


Fig 3.11: Badda Thana

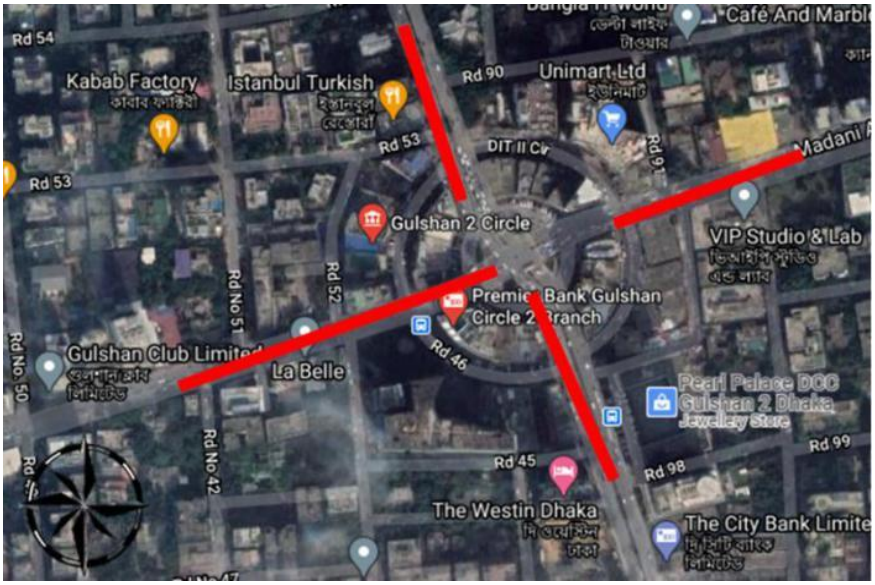


Fig 3.12: Gulshan 2 circle area

3.6 Specifications of the Software

In 1985, STATACORP released the first version of STATA, a statistical analysis program. Statistics, graphics, simulations, regression and custom programming are all areas of expertise for STATA. Statistical software STATA was used to develop Structural Equation Modeling, SEM. A spreadsheet was created to compile all the survey results after verifying their completeness and ensuring that they were all in the correct format. The places were assigned numbers, and the data was entered using those numbers. At first data needs to be prepared in Excel; entered into STATA in SEM mode

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter discusses the process of model development and its interpretation. All the graphical and numerical relationship among the exogenous and endogenous variables is shown in this chapter.

A comprehensive questionnaire survey was conducted in Dhaka city to know the actual scenario of ridesharing services. The questionnaire had six main sections containing 27 questions. The survey locations were selected where rideshare services are available. Total eleven major locations are selected based on the availability of ride sharing services in Dhaka city. The survey was conducted in peak hours so that ample number of respondents could be found. Person to person interview survey was conducted in each location to take users' opinion about the ridesharing service. Usually, respondents were very busy at office time so sometimes surveyors had to make a trip with them to complete the survey.

4.2 Questionnaire Survey

4.2.1 List of Variable

Table 4.1. shows the list of variables:

Table 4.1: List of Variables

Serial No	Variable	Serial No	Variable
1	Age	11	Trip purpose
2	Gender	12	Mode of transportation
3	Educational Qualification	13	Waiting time
4	Occupation	14	Choice of rideshare
5	Income	15	Safety perception
6	Vehicle ownership	16	Level of comfort
7	Travel expenses	17	View towards rideshare
8	Trip schedule	18	Interest level
9	Trip distance	19	Importance of rideshare
10	Willingness to pay fare	20	Willingness to change schedule

Serial No	Variable	Serial No	Variable
21	Frequency of using	25	Preschedule trip
22	Distance meet a partner	26	Limitation
23	Service quality	27	Improvement
24	Waiting time (passengers)		

4.2.2 General Characteristic of the Respondents

Table 4.2. presents descriptive statistics on respondents' demographic, socio-economic and general characteristics. Respondents were requested to state their opinion about the service attributes on a five-point Likert scale varying from 1 to 5 where 1 is for very poor and 5 is for excellent. From table 4.1 it can be depicted that most of the respondents (79%) are male and majority (78%) of them are from 20 to 39 years old. About 67% of the users have graduate or post-graduate level of education. Half (53%) of the users are full time and part time government/private job holders. Most (79%) of the users do not own any private vehicles. About 29% of the respondent's monthly income is within 20,000 BDT - 40,000 BDT but half (51%) of the respondents' monthly travel expenditure is between 1000 BDT – 5000 BDT.

Table 4.2 General information of respondents

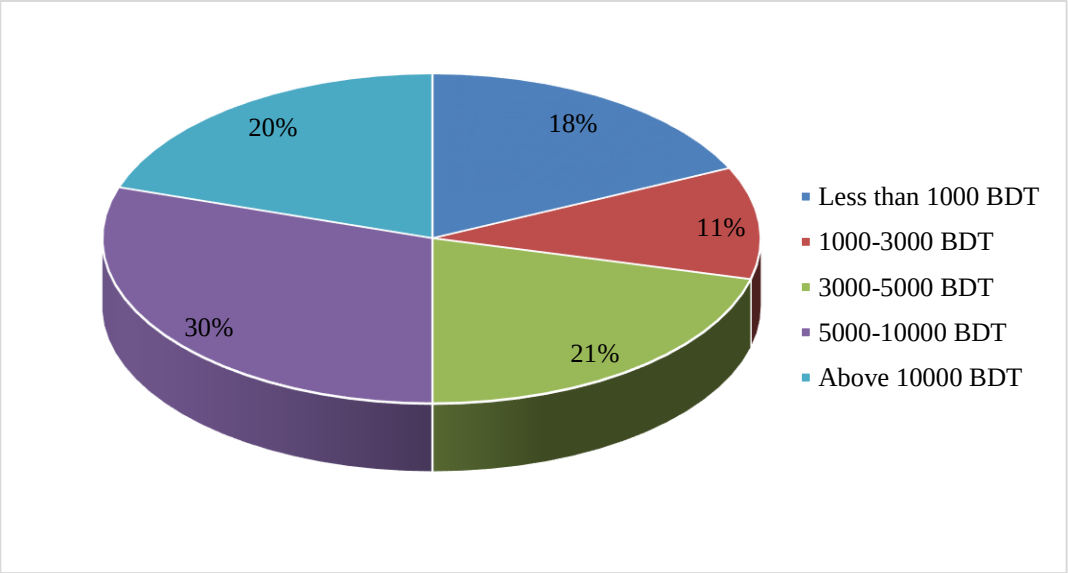
Characteristics	Statistics	Percentage
Gender	Male	79%
	Female	21%
Age	< 20 years old	2%
	20-29 years old	43%
	30-39 years old	35%
	40-49 years old	14%
	> 59 years old	6%
Education qualification	Un-Educated	2%
	Primary (J.S.C)	3%
	S.S.C	3%
	H.S.C	25%
	Graduates	56%
	Post Graduates	11%

Occupation	Government/Private Job (Full Time)	44%
	Government/Private Job (Part Time)	9%
	Business	17%
	Student	24%
	Other	6%
Monthly income	Less than 5000 BDT	21%
	5000 BDT - 10,000 BDT	11%
	10,000 BDT - 20,000 BDT	20%
	20,000 BDT - 40,000 BDT	29%
	More than 40,000 BDT	19%
Vehicle owner	Yes	21%
	No	79%
Monthly travel expenditure	Less than 1000 BDT	21%
	1000 BDT - 5000 BDT	51%
	5000 BDT - 10,000 BDT	19%
	10,000 BDT - 20,000 BDT	6%
	Above 20,000 BDT	3%

1 US $ = 100 BDT.

4.2.3 Travel Expenditure

Fig 4.1. shows that about 30% of the respondents consider monthly travel expenditure of 5000 BDT to 10000 BDT while 20% told their monthly travel expenditure between 3000 BDT to 5000 BDT. About 20% and 18% of the respondents mentioned that they spend above 10000 BDT and



less than 10000 BDT respectively for travel purpose.

Fig 4.1: Travel Expenditure

4.2.4. Trip Schedule

Result shows that about half of the respondents (51%) schedule of trip is between 7:00 a.m. to 9:00 a.m. while 34% of their trip schedule is from 9:00 a.m. to 11:00 a.m. as shown in Fig 4.2.

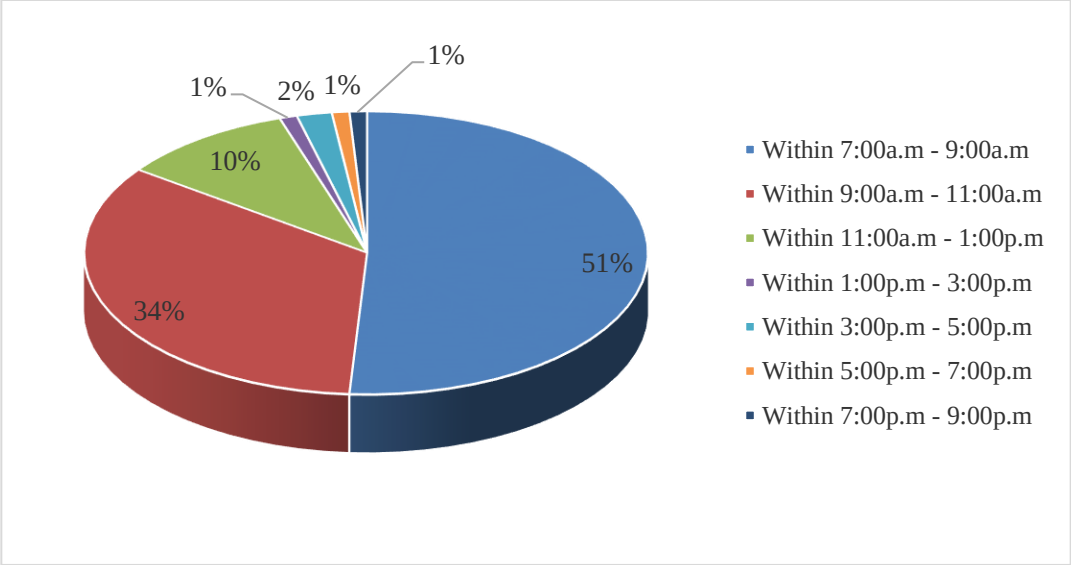


Fig 4.2. Trip Schedule

4.2.5 Trip Distance

About 35% of the respondents mentioned that their trip distance is within 5 km – 10 km and 17.17% mentioned it within 10 km – 20 km. About 36.24 % and 2.86% of the respondents said that their trip distance is less than 5km and more than 20 km respectively as shown in Fig 4.3.

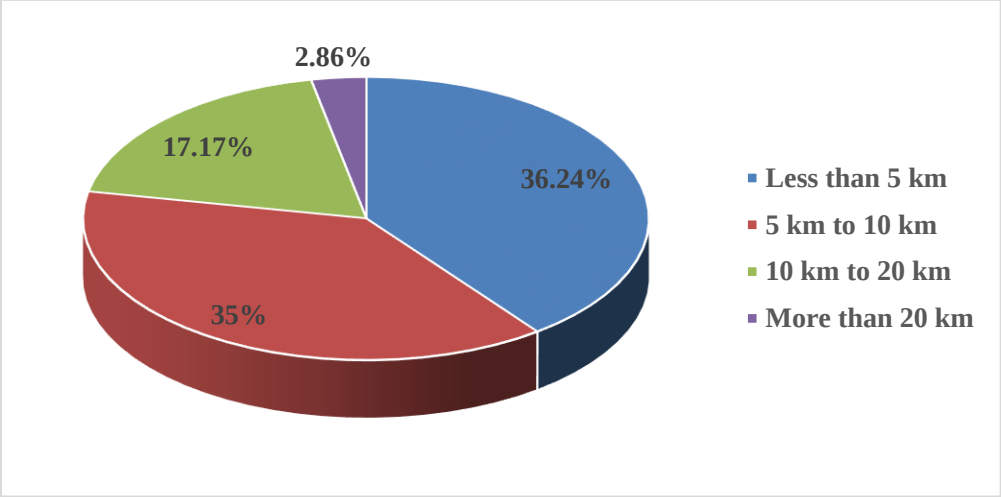


Fig 4.3 : Trip distance

4.2.6 Willingness to Pay Fare

Fig 4.4. shows the respondents willingness to pay for rideshare within Dhaka city. About 10.17% of the respondents replied that they are willing to pay less than 50 BDT for rideshare trip while 19.39 % of them are willing to pay 50 BDT – 100 BDT. Only 70.44% of them expressed that they are willing to pay more than 100 BDT for a shared ride.

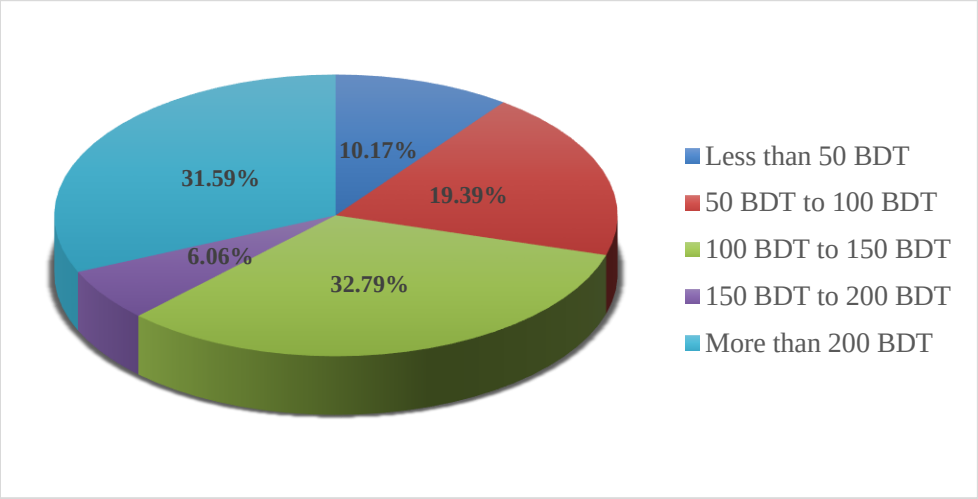
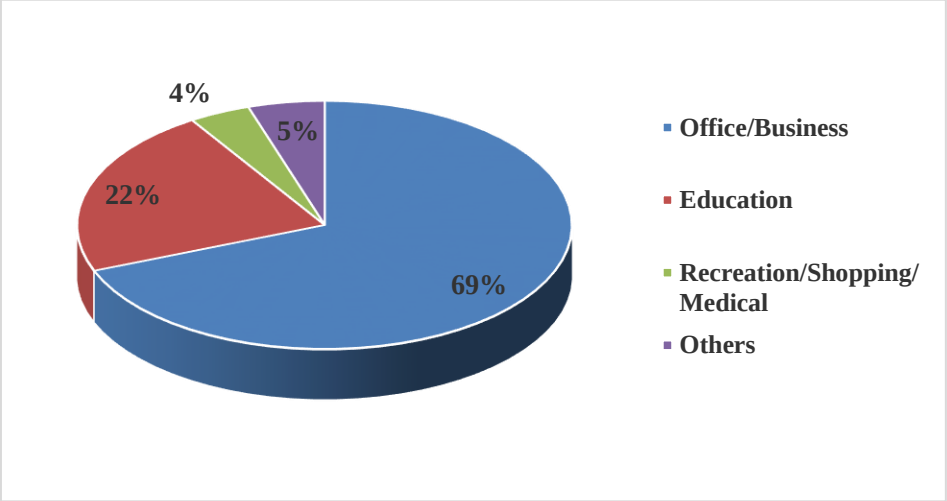


Fig 4.4 : Willingness to pay fare

4.2.7 Trip Purpose

Majority (69%) of the respondents answered that their trip purpose is office or business as shown in Fig 4.5. On the other hand, 22% and 4% of the respondents' trip purpose is education, and



recreation/shopping/medical respectively.

Fig 4.5: Trip purpose

4.2.8 Mode of Transportation

About half of the respondents' (56%) main mode of travel is bus/train/tempo (tempo is a type of motorized paratransit in Bangladesh) while 21% of the respondents' main mode of travel is private car as shown in Fig 4.6.

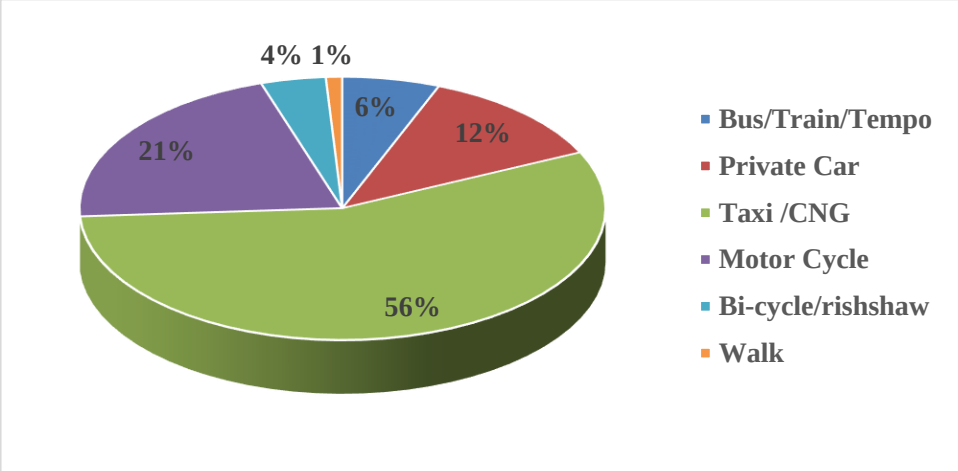


Fig 4.6: Mode of transportation

4.2.9 Waiting Time

More than half (58.61%) of the respondents are willing to wait less than 10 minutes for a ride, while 35.29% of the respondents' are willing to wait 10-20 minutes as shown Fig 4.7.

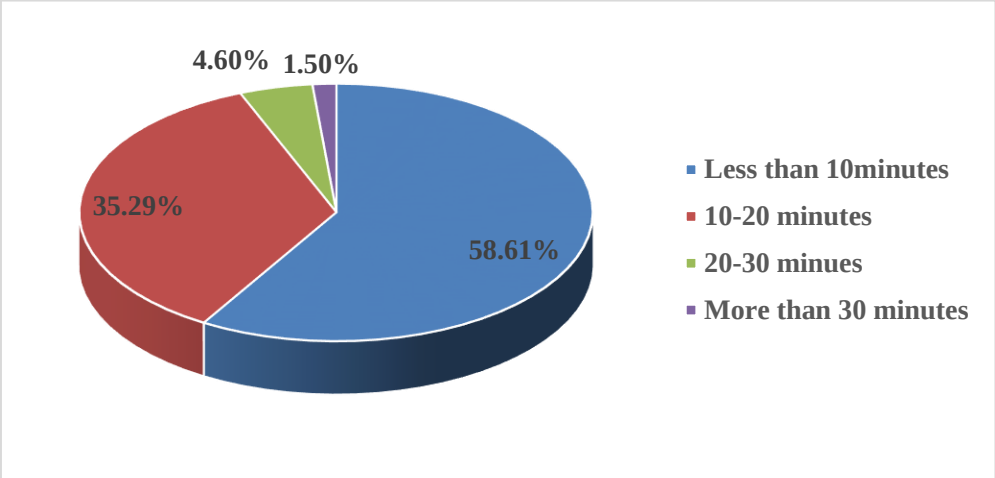


Fig 4.7: Waiting time

4.2.10 Choice of Rideshare

Fig 4.8. shows that above half of the respondents (56%) choose rideshare for comfortable trip while 35% of them choose for financial saving due to shared commuting. About 4% of the respondents mentioned that safety and to decrease personal vehicles maintenance wear & tear is the main reason to choose the rideshare services.

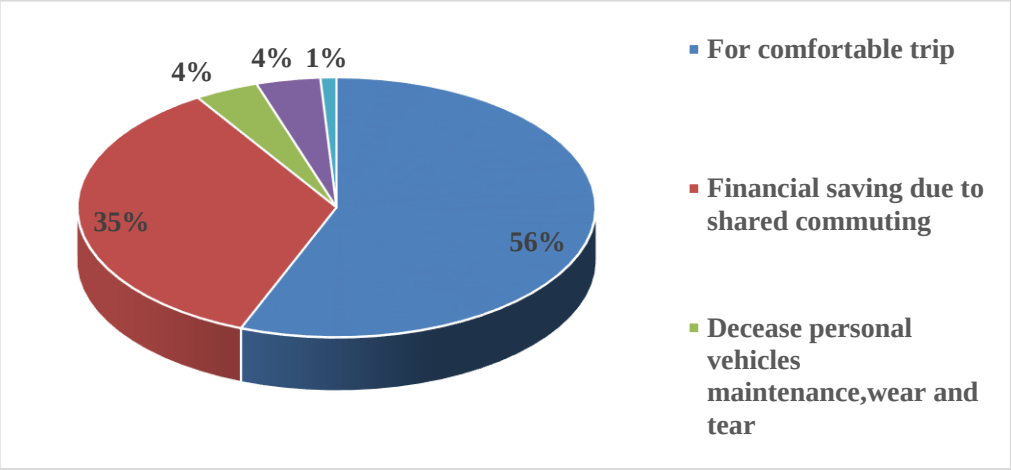


Fig 4.8: Reason to choice rideshare service

4.2.11 Safety Perception

Fig 4.9. shows that most of respondents consider rideshare as a safer mode of transport. About 7% respondents do not consider rideshare as a safer mode of transport.

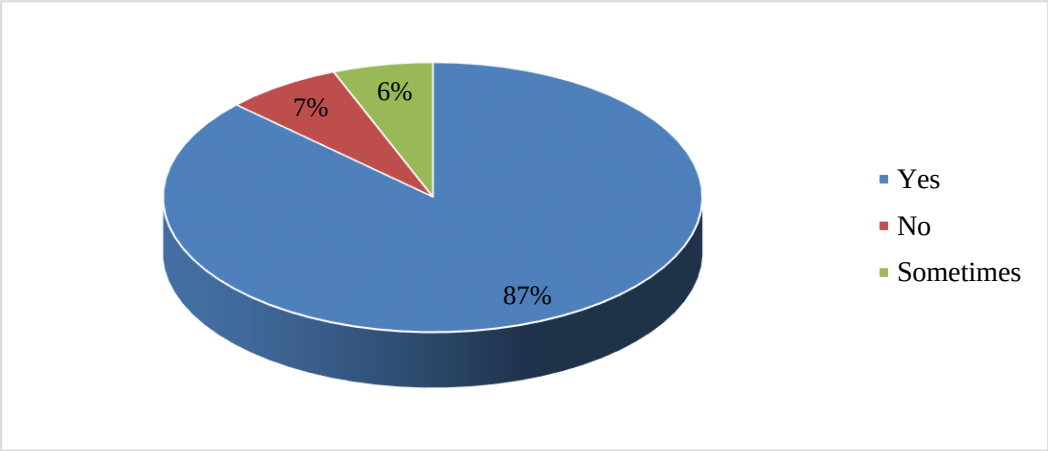


Fig 4.9: Safety perception

4.2.12 Level of Comfort

Fig 4.10. shows that about one third of the respondents (33%) felt uncomfortable during rideshare due to share with unknown while 19% of respondents felt comfort due to regular travel experience.

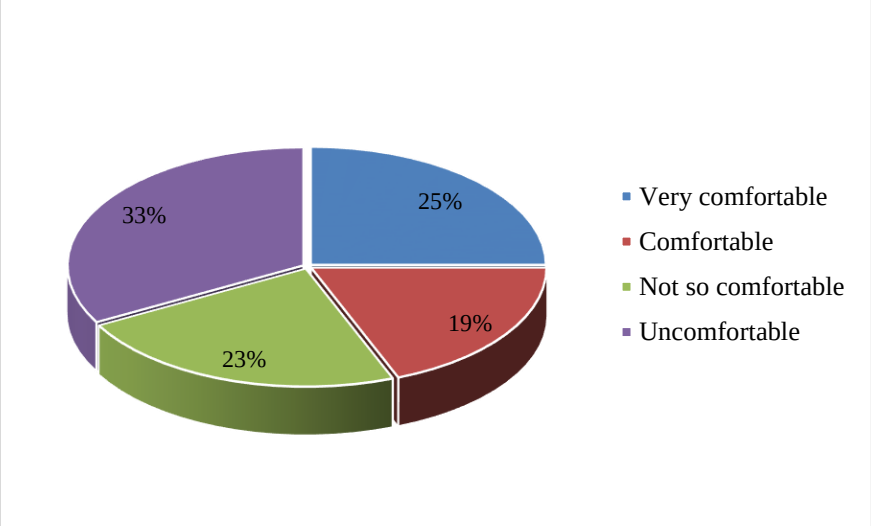


Fig 4.10: Level of comfort

4.2.13 View towards ridesharing

Fig 4.11. shows respondents' views towards ridesharing. 1.7 % of them replied that if safety is

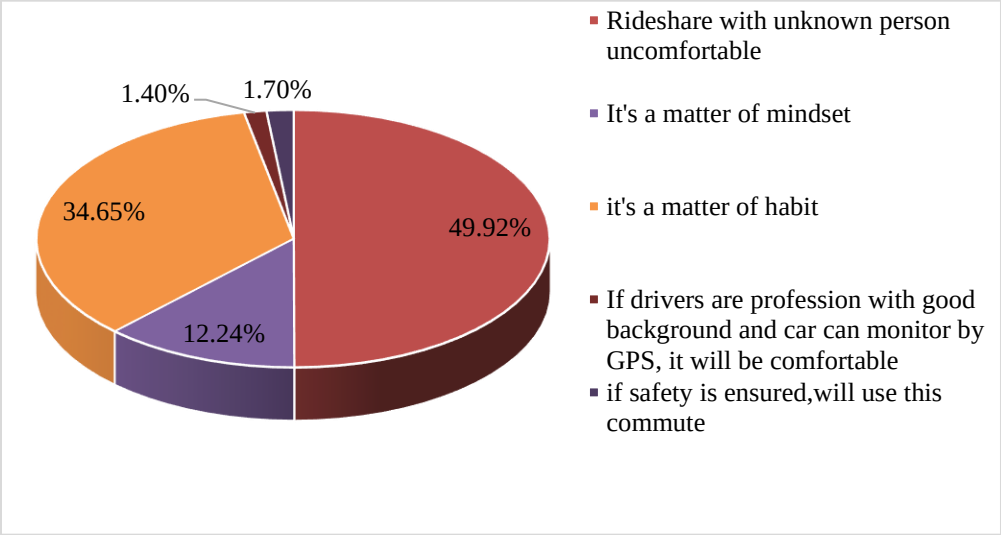


Fig 4.11: View towards rideshare services

ensured they will use this commute while 49.92% replied that rideshare with unknown person is uncomfortable, 12.24% said that it is a matter of mindset/habit, 34.65% said that if drivers are professional with good background and car can be monitored by GPS it will be comfortable.

4.2.14 Interest Level

Fig 4.12. shows that more than half of the respondents (58%) replied that they are interested as they have not much options of transport services while 22% of the respondents do not have internet to use the rideshare services.

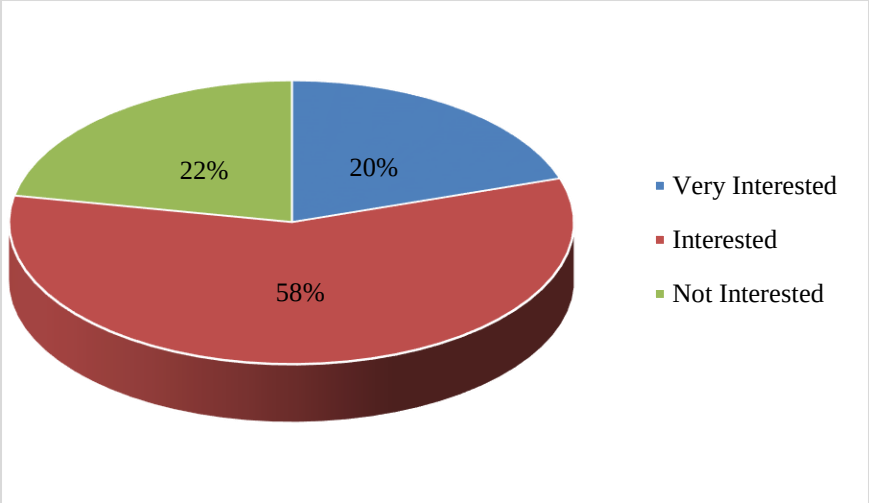


Fig 4.12: Interest level

4.2.15 Importance of Rideshare

Fig 4.13. shows the importance of ridesharing based on users' perception. About 41% of the respondents perceive that the ridesharing service is important since it provides access to public transit routes, businesses and services with limited parking while 19% of the respondents replied that rideshare fills the service area gaps by existing transit services and also lowers some environmental concerns like emission of greenhouse gas. 21% of the respondents said that rideshare contributes to the excessive market demand from customers for transport.

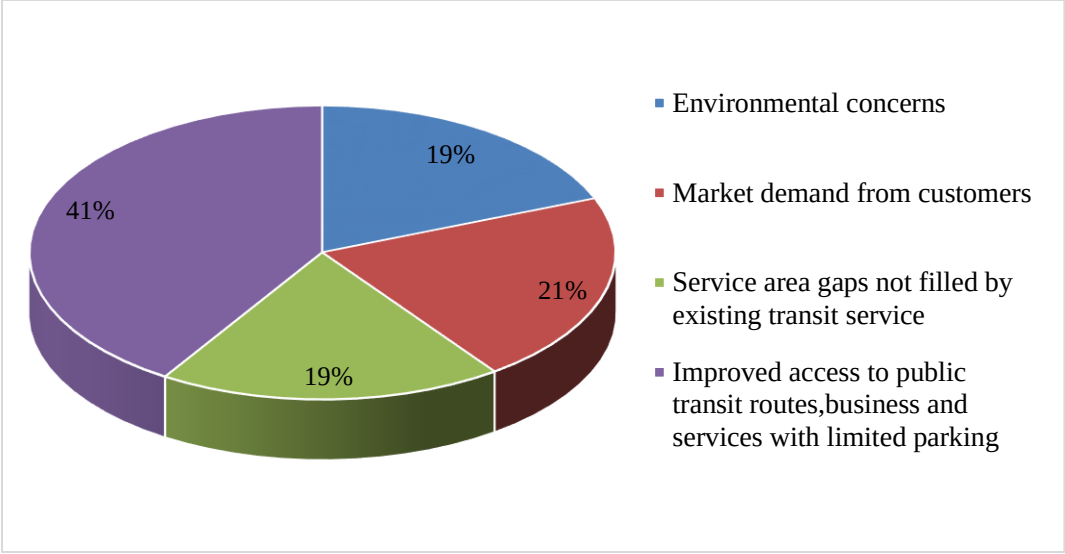


Fig 4.13: Importance of rideshare services

4.2.16 Willingness to Change Schedule

Fig 4.14. shows whether the respondents are willing to change their work schedule to join rideshare. About 39% of the users are willing to change their schedule but not able to change because of their fixed work schedule. Conversely 53% of them are willing and able to change their work schedule to join rideshare. Only 8% of the users said that they do not have any interest in changing their work schedule to join rideshare.

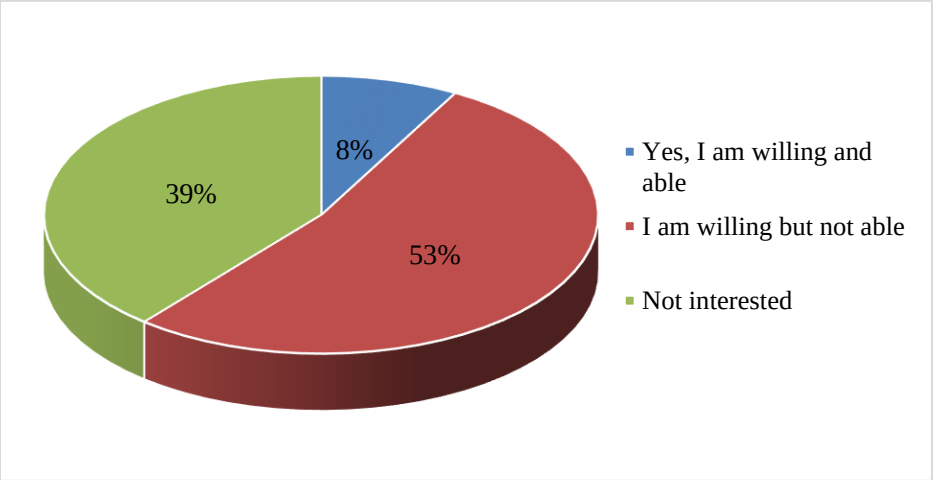
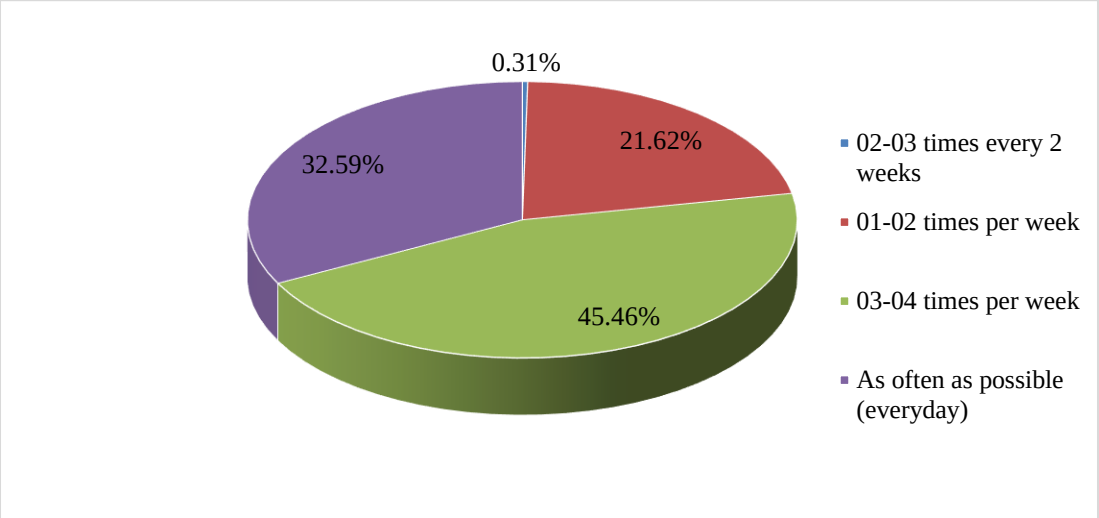


Fig 4.14: Willingness to change work schedule

4.2.17 Frequency of Ridesharing

Fig 4.15. shows that about 45.46% respondents share their ride 3 to 4 times in a week while



32.59% respondents avail rideshare as often as possible.

Fig 4.15: Frequency of Ridesharing

4.2.18 Distance to Meet a Partner

Half of the respondents (52%) replied that they are willing to travel less than 1 kilometer for meeting a rideshare partner as shown in Fig 4.16. 1-2 kilometers, more than 3 kilometers and 2-3 kilometers are mentioned by 23%, 16% and 9% of the respondents respectively for meeting a rideshare partner.

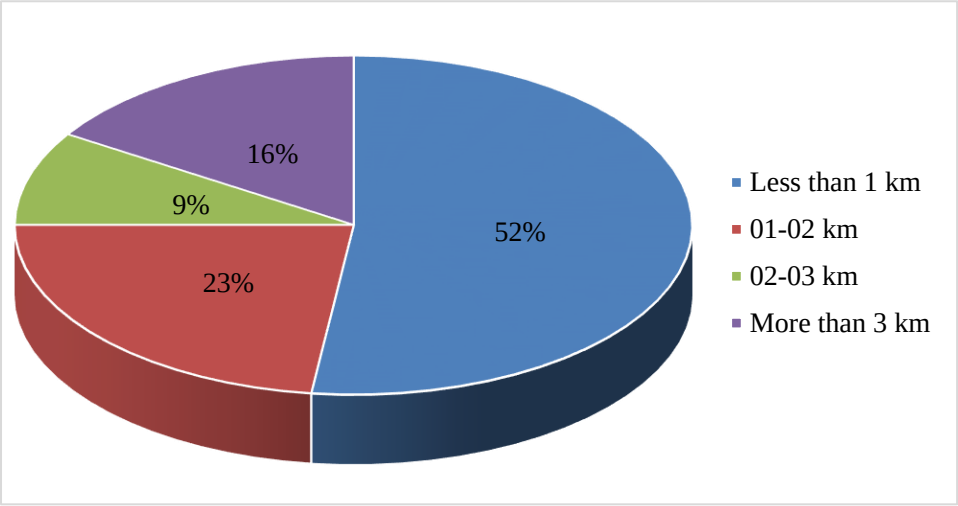


Fig 4.16: Distance to meet a partner

4.2.19 Service Quality

About 28% of the respondents said that the service quality of rideshare is good while 4% mentioned it is satisfactory as shown in Fig 4.17. 24% and 44% of the respondents mentioned that the service quality of rideshare is excellent and very good respectively.

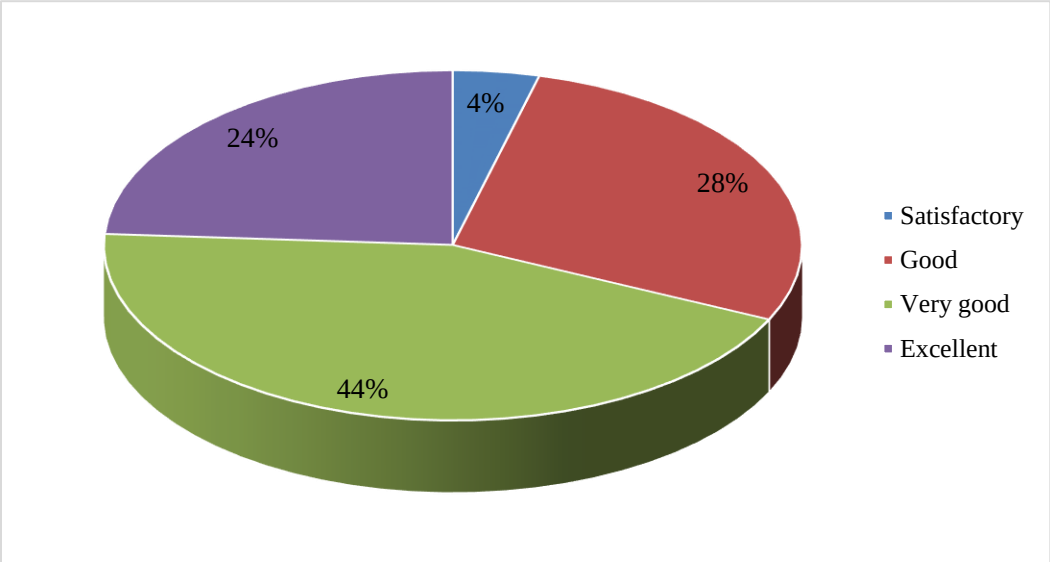


Fig 4.17: Service Quality of Rideshare

4.2.20 Waiting Time

More than half (65%) of the respondents are willing to wait less than 10 minutes for a ride, while 25% of them are willing to wait 10-20 minutes as shown Fig 4.21.

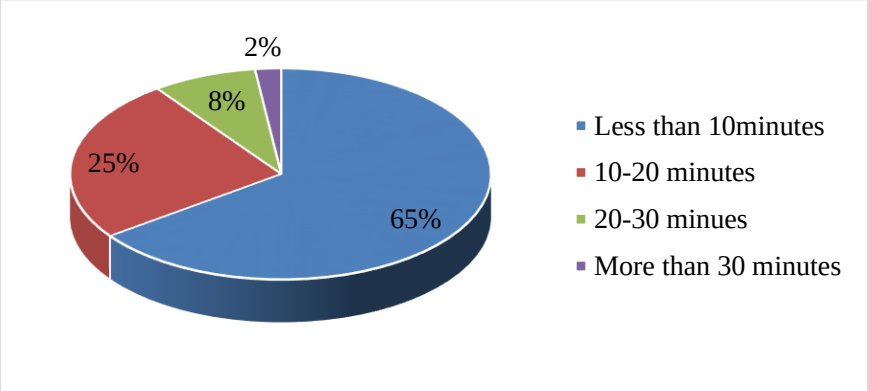
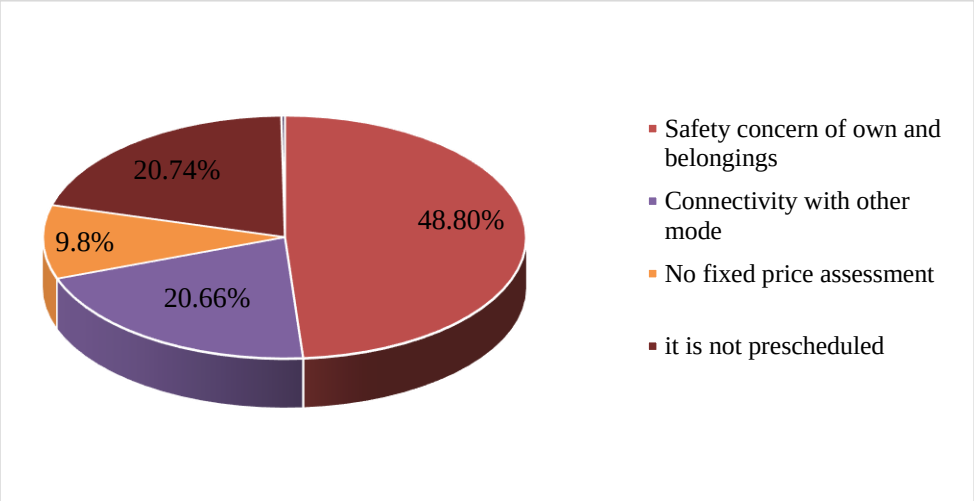


Fig 4.18: Waiting time for passengers

4.2.21 Challenges of Rideshare

In Fig 4.19. 48.80% of the respondents said that they are concerned with the safety of their own and also their belongings while 9.80% of the respondents mentioned that there is no specific information regarding the service and there is no fixed price for ridesharing are the main limitations of the services. Respondents were also mentioned that lack of connectivity with other



mode (20.66%), and rideshare being not always prescheduled (20.74%) are the limitations of ridesharing.

Fig 4.19: Challenges during rideshare

4.2.22 Improvement

Fig 4.20. shows the measures necessary for improvement of rideshare as perceived by the respondents. 20.58%, 21.62%, 18.91% and 15.42% of the respondents expressed to provide guaranteed ride home, help to establish ridesharing with vehicles of different agency, provide parking for ridesharing, and to provide rideshare matching for improvement of rideshare. Whereas 10.01%, 5.4%, 5.4% and 19.26% of the respondents indicated to subsidize ridesharing fares, market ridesharing to businesses or transit riders, provide incentives (e.g., loyalty programs, commuter checks, prizes, recognition) and other measures respectively for improving the services.

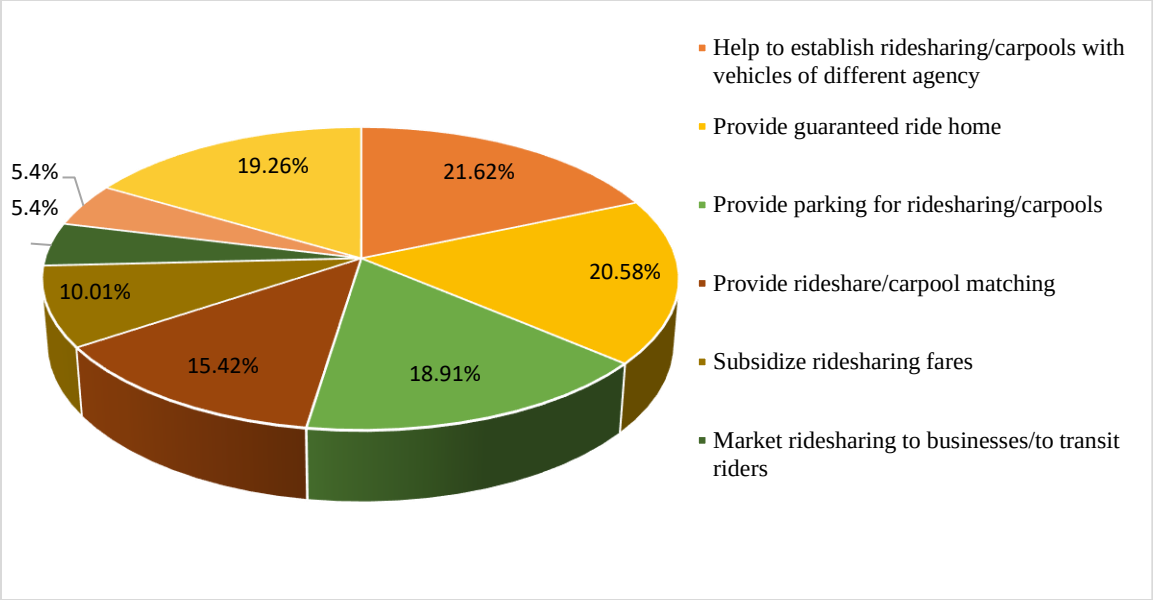


Fig 4.20: Measusers for Improvement

4.3 Interview Survey

An interview survey was conducted to the rideshare operators in several locations in Dhaka city. Total 25 operators were interviewed. Several questions were asked to them regarding the rideshare services, and the challenges they faced and the prospects about ridesharing in Dhaka city.

4.3.1 Distant to Meet a Partner

In Fig 4.21. Half of the respondents (66%) replied that they are willing to travel less than 500 meters for meeting a rideshare passengers as shown in Figure 4.20 . 500 meters -1 kilometers, 01-02 kilometers and more than 2 kilometers are mentioned by 25%, 6% and 3% of the respondents respectively for meeting a rideshare passengers .

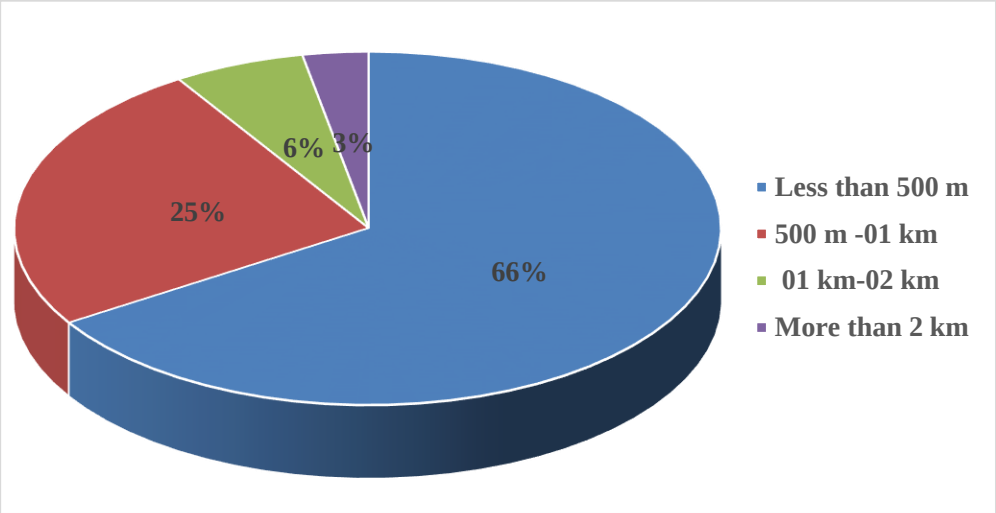


Fig 4.21: Distance to meet rideshare partner

4.3.2 Waiting Time

More than half (65%) of the respondents are willing to wait less than 5 minutes for a ride, while 25% of them are willing to wait 5-10 minutes as shown Fig 4.22.

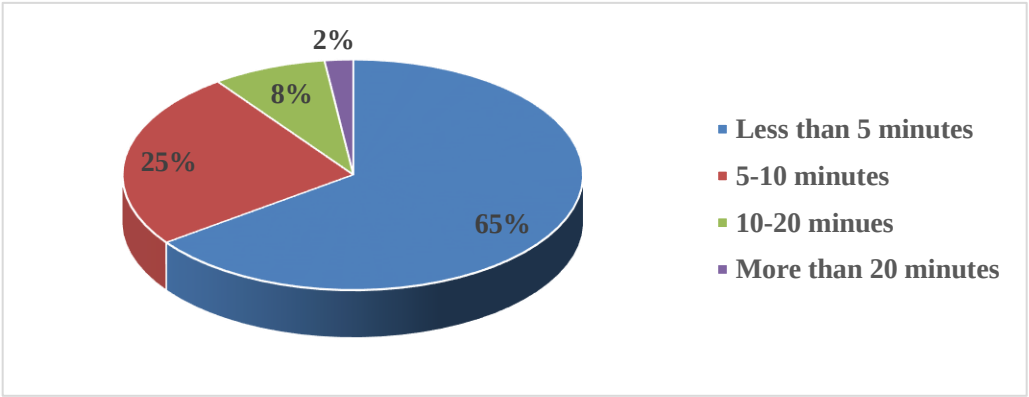


Fig 4.22: Waiting time for passengers

4.3.3 Challenges of Rideshare

62% of the respondents said that they are concerned with the safety of own and their vehicles while 25% of the respondents said that very often they are harassed by the law enforcing agencies. 9% of the respondents mentioned that many a time the ridesharing companies provide special discount to attract the passengers and for that the fare reduces that are shown in Fig 4.23.

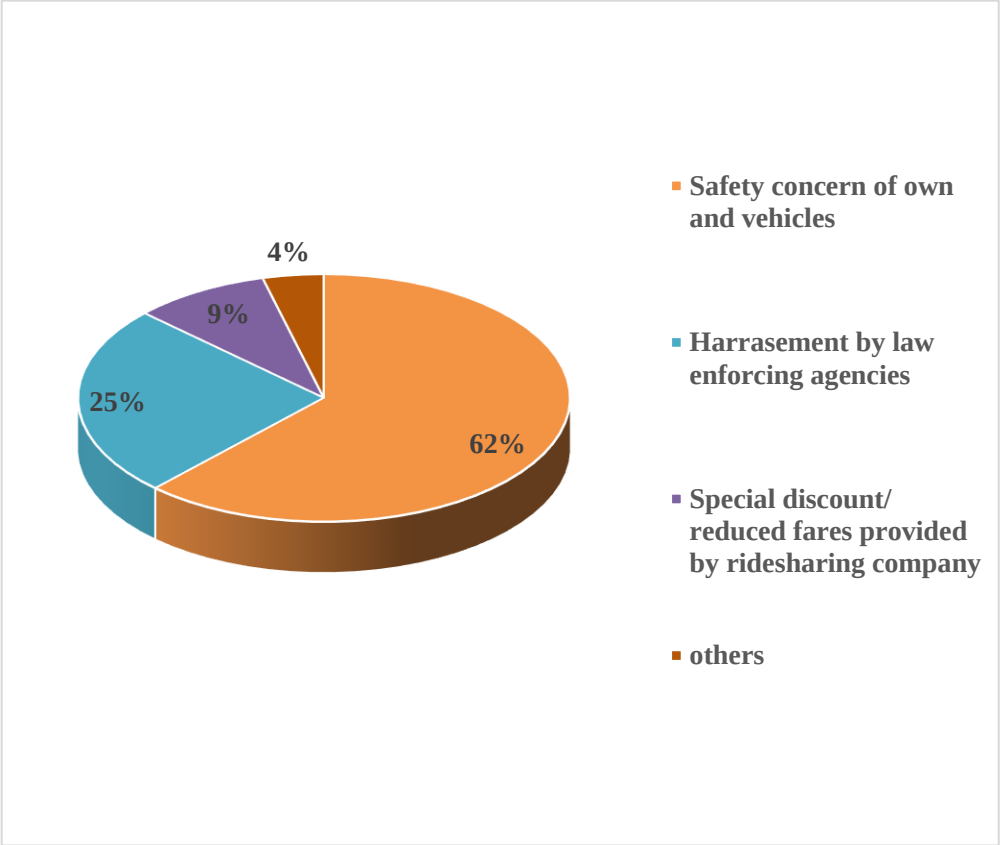


Fig 4.23: Challenges of rideshare

4.3.4 Prospects of Rideshare

Fig 4.24. shows the prospects of ridesharing within Dhaka city in view of operators. 55% of the respondents opined that ridesharing services has become a new mode of transportation as the popularity of ridesharing is going high. 25% respondents opined that their employment opportunities have been increased as new ridesharing services are coming up while 11%

respondents said that traffic jam and road congestion have been reduced due to more ridesharing services. 7% of the respondents thought that there is a huge opportunities for foreign investment in this sector.

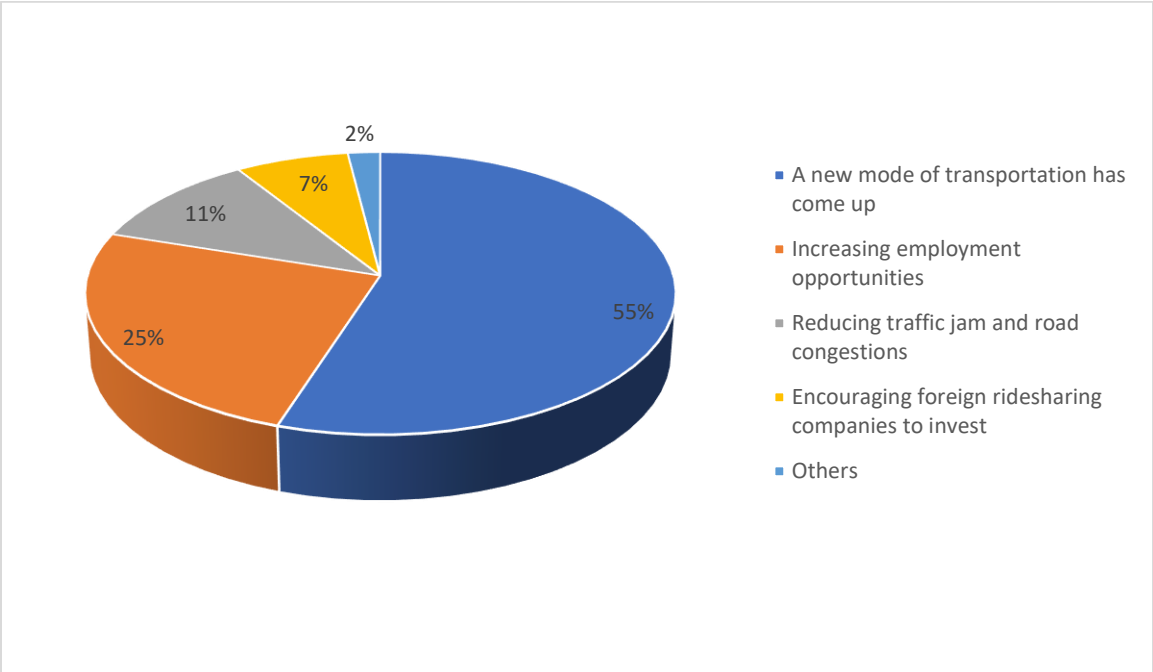


Fig 4.24: Prospects of rideshare

4.4 Model Development

Sample size in SEM is important since it influences the consistency of parameter estimates, model fitness and statistical power of SEM (Shah and Goldstein, 2006). For convergence of model, it is suggested that the sample size should be between 5-10 per observed variable (e.g., Byrne, 2006). SEM requires considerable samples since it is a large sample approach (Lin et al., 2007). Anderson and Gerbing (1984) alleged a minimum sample size of 100 is satisfactory for SEM assessment. Kline (2011) mentioned that above 200 items are estimated to obtain sound outcomes. Klien (2005) stated that minimum 200 sample is mandatory for survey research. For moderate complex models, a sample size of about 400 is suggested by golob (2003). As per thumb rule, the ratio of factors of sample size can be 20 to 1 as maximum (klien, 2005) or 5 to 1

as minimum (golob, 2003). This research considers total 675 samples with 32 SQ variables which is adequate

4.4.1 Preliminary Statistics

Following Table 4.3. shows the frequency distribution of all variable included in service quality of rideshare. It also shows the mean, standard deviation, minimum and maximum value of all variables for better understanding of collected survey data.

Table 4.3: Preliminary statistics

Serial No	Variable	Respondent	Mean	Std. Dev.
1	Travel expenses	628	2.183	0.916
2	Trip schedule	628	1.688	0.913
3	Trip distance (Approximate)	628	2.188	0.891
4	Willingness to pay fare	628	1.557	0.767
5	Trip purpose	628	1.439	0.769
6	Mode of transportation	628	1.960	1.450
7	Waiting time for passengers	628	1.451	0.592
8	Choice of ridesharing services	628	1.688	0.790
9	Safety perception	628	2.197	1.128
10	Level of comfort	628	2.013	0.738
11	View Towards Rideshare	628	2.830	1.162
12	Interest level	628	2.320	0.609
13	Importance of rideshare service	628	2.710	1.279
14	Willingness to change work schedule	628	1.892	0.731
15	Frequency of using rideshare	628	2.072	1.487
16	Distance to meet rideshare partner	628	2.196	1.159
17	Service quality	628	3.010	1.047
18	Prescheduled trip	628	2.369	1.063
19	Limitation	628	2.268	1.269
20	Improvement	628	3.387	1.813

4.5 Structural Equation Model

In this study, four models of distinct configurations are developed and tested to obtain the best one. For developing SEM, 27 SQ attributes were employed. For the ease of identification usual symbols are used:

X designates exogenous observed variables; *Y* and y specifies endogenous observed variables; *Z* designates total SQ of ridesharing; η designates latent variables; ρ and ε designates measurement errors in y and Y respectively; ζ *and* δ designates errors in η and *Z* respectively; λ designates

coefficient of Y variables; α, γ *and* μ specifies coefficient of η variables when effect Y, y and Z variables respectively; Γ specifies coefficient of x variables. For better comprehending of SEM structure, the basic equations by Bollen (1989) are introduced.

4.6 Goodness-of-Fit (GFI)

To measure the model fitness several measures are observed. Tabachnick and Fidell (2007) stated that the Goodness-of-Fit statistic (GFI) is the substitute of the Chi-Square analysis and estimates the fraction of inconsistency and anticipated covariance of population. How precisely a model appears to reproduce the observed covariance matrix is estimated by the covariance and variance (Diamantopoulos and Siguaw, 2000).

According to Hooper et al. (2008) some strategies are available for ascertaining model fitness, where fit indices are discriminated as incremental, parsimony and absolute. Several fit indices are employed to examine how good a model fits the observed data indices by total fit. Some commonly employed measures to outline model fitness are Standardized Root Mean Squared Residual (SRMR), Root Mean Squared Error of Approximation (RMSEA), Tucker-Lewis index (TLI) and Comparative fit Index (CFI). For classifying factors, a value of 1.64 for 90% of confidence limit from two tailed t-test is chosen. A model with a RMSEA value of smaller than 0.05 or 0.10 is deemed as 'very good' or 'good' respectively (Steiger, 1990). A value of RMSEA ≤0.08 can be counted as moderate (Browne and Cudeck, 1993). Vandenberg and Lance (2000) suggested a value of SRMR lower than 0.10 denotes a well fit. Hooper et al., (2008) indicated a CFI value nearer to 1.0 designates a good fit. Moreover, a model with the lowest AIC value is counted as the best.

Model 1 (M1)

Model 1 hypothesizes that overall service quality of ridesharing (Z) has two main components: perceived importance of the service for filling travel needs not filled by public bus and comfort. Both components are predicted by individual sociodemographic, travel attributes, experience with ridesharing information, waiting, prescheduling, payment, and aspects of safety. The path diagram of M1 is shown in Figure 2. From M1 equation 1 can be written.

$$Z = \lambda_o + \lambda * Y + \delta \quad \text{……………………………………………} \quad (1)$$

Y employed in Eq. (1) may be expressed as:

$Y = \Gamma * X + \varepsilon$ ……………………………………………………(2)

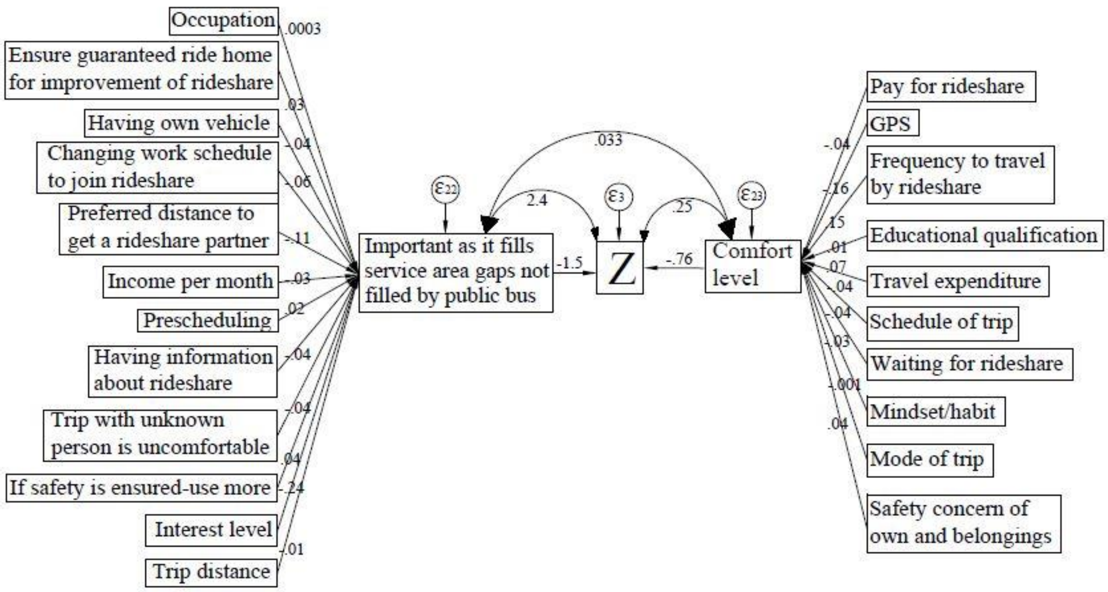


Fig 4.25: Path diagram of M1

Model 2 (M2)

Model 2 hypothesizes that overall service quality of ridesharing (Z) has three main components: aspects of safety, the perceived importance as it fills service area gaps not filled by public transport and comfort. These components are predicted by two latent variables calibrated by individual sociodemographic, travel attributes, mode of trip, schedule of trip, trip distance, aspects of safety and experience with ridesharing information. The structure of M2 is shown in Figure 3. Following equation can be formulated from M2.

$Z = \lambda_o + \lambda * Y + \delta$ ……………………………………… (3)

Where Y in Eq. (8) represents the endogenous variables

$Y = \alpha\, \eta + \varepsilon$ …………………………………………… (4)

and y represents the remaining endogenous variables

$y = \lambda * \eta + p$ ……………………………………………(5)

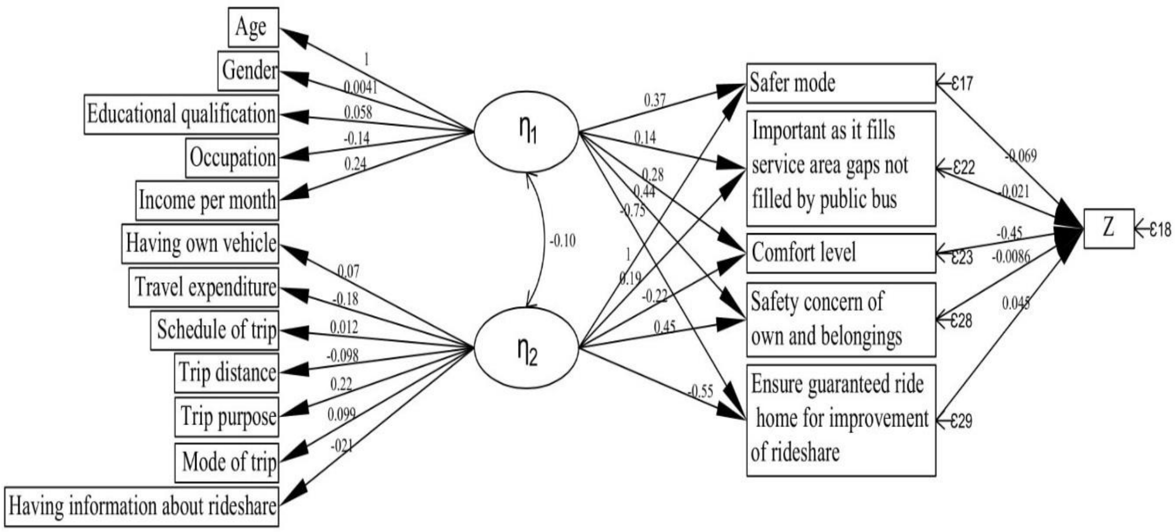


Fig 4.26: Path diagram of M2

Model 3 (M3)

Model 3 hypothesizes that overall service quality of ridesharing (Z) has three main components. These components are calibrated by individual sociodemographic, travel attributes, mode of trip, schedule of trip, trip distance, aspects of safety, experience with ridesharing information, waiting, prescheduling, payment, mindset/habit, travel frequency, and consider ridesharing for financial savings.

The structure of M3 is shown in Figure 3. Following equation can be formulated from M3.

$Z = \lambda_o + \lambda * Y + \delta$ ………………………………………. (6)

In Eq. (6) η denotes the latent variables calibrated from endogenous variables

$\eta = (\gamma - \rho)/\gamma$ ……………………………………………… (7)

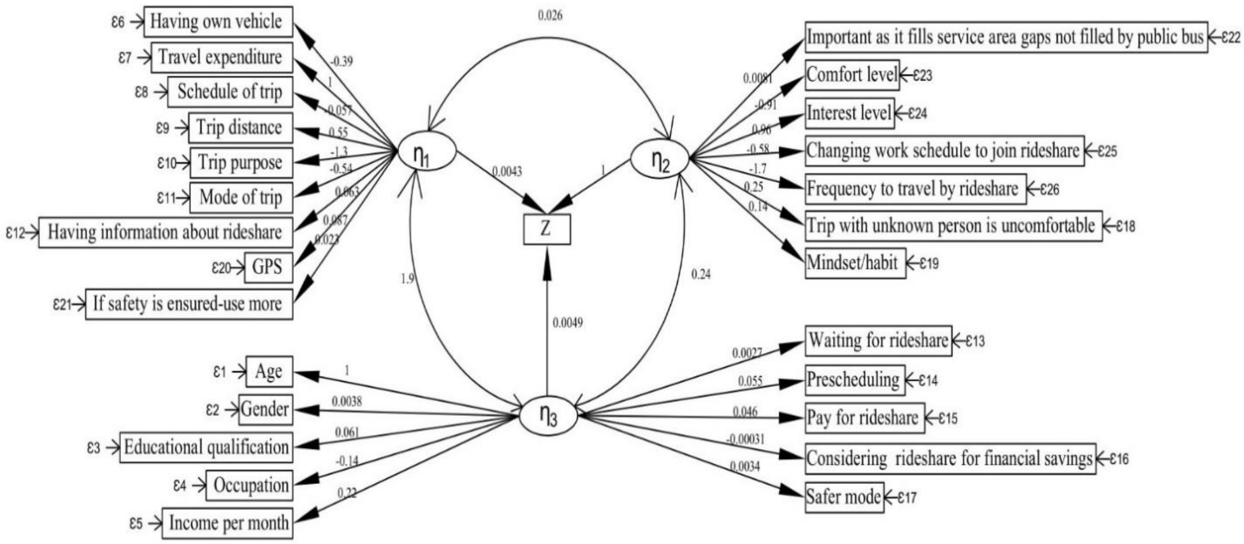


Fig 4.27: Path diagram of M3

Model 4 (M4)

Model 4 hypothesizes that overall service quality of ridesharing (Z) has four main components: Ensure guaranteed ride home for improvement of ridesharing, perceived importance of the service for filling travel needs not filled by public bus, comfort, and safety concerns. These components are predicted by a latent variable which is calibrated by travel attributes, financial aspects, prescheduling, payment, aspects of safety, mindset/habit, mode of trip and individual sociodemographic. The path diagram of M4 is shown in Figure 5. From M4 following equation can be written.

$$Z = \lambda_o + \lambda^* Y + \delta \quad (8)$$

Y in Eq. (3) represents the endogenous variables

$$Y = \alpha\, \eta + \varepsilon \quad (9)$$

And η denotes the latent variables calibrated exogenous variables

$$\eta = \Gamma X + \zeta \quad (10)$$

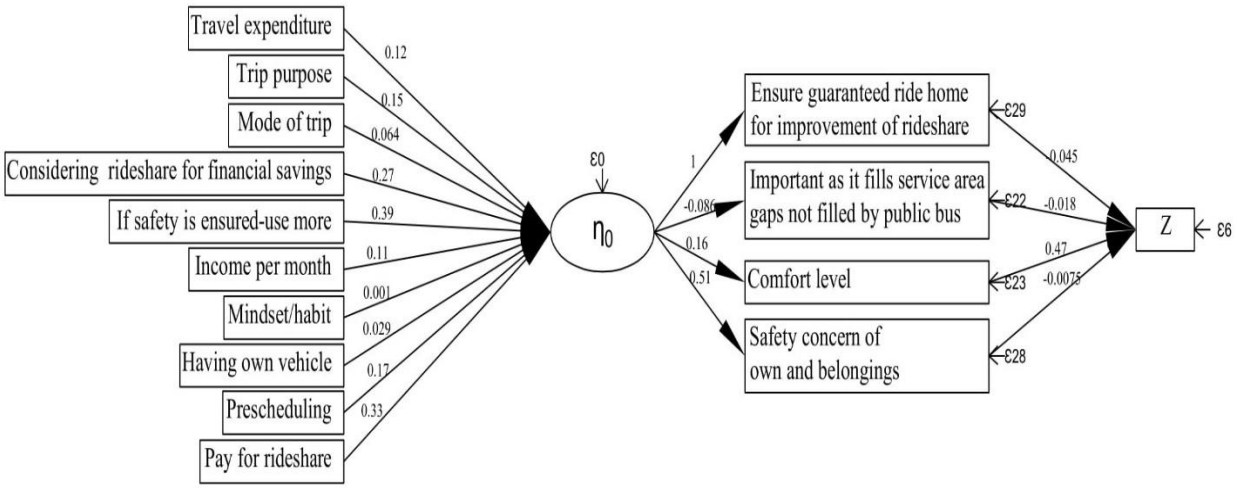


Fig 4.28: Path diagram of M4

4.7 Results

This research explores overall ridesharing SQ by four models (M1, M2, M3 and M4). Table 2 is the summary that brings together the parameter values of the variables employed to construct the models. The significant variables are revealed from the parameter values. By comparing the models, the best one was chosen. The values of RMSEA, SRMR, CFI and AIC of the four models are shown in Table 4.4.

Two endogenous variables 'Important as it fills service area gaps not filled by public transport' and 'Comfort level' are employed to develop M1. Variables are rearranged and the best assembly with this format is found to explain the model construction. Travel expenses, frequency to travel by ridesharing, preferred distance to get a ridesharing partner and limitation (of ridesharing service) influence SQ positively where trip schedule, comfort level and interest level influence SQ negatively. However, the results of M1 (-0.76; Z- value 0.001) indicates comfort level is significant but it affects ridesharing SQ negatively which does not represent the actual situation. Since comfortable vehicles are always desired by the commuters; comfort level should affect SQ positively. On the other hand, safety perception is a major variable which is insignificant (0.039; Z- value 0.493) and it influences SQ positively. Fit indices of M1 are as

follows CFI = 0.576, RMSEA = 0.078, SRMR = 0.028; Table 3. RMSEA value is good but very low CFI value implies poor fit.

Model M2 presents two latent variables η_1 and η_2, where latent variable (η_1) is calibrated by five endogenous variables and latent variable (η_2) is constructed with seven endogenous variables. Again, the two latent variables are correlated by covariance, connecting η_1 and η_2 (with coefficient value -.1 and Z- value 0.142). The latent variables influence the five endogenous variables: safer mode, comfort level, safety concern of own and belongings and measures to improve ridesharing. Like M1 comfort level influences ridesharing SQ negatively (coefficient value -0.45; Z- value 0.000). Safer mode is an important variable which is insignificant influencing SQ negatively (coefficient value -0.067; Z- value 0.107). The results of M2 indicates fit indices as CFI = 0.632, RMSEA = 0.082, SRMR = 0.068. M2 is not regarded the desired model considering the real situation.

Model M3 is developed with twenty-six endogenous variables and three latent variables (η_1, η_2, η_3). The latent variables, (η_1, η_2 and η_3) are calibrated with nine, seven and ten endogenous variables respectively. These three latent variables are correlated by covariance, connecting η_1 and η_2 with significance value 0.026 (with Z- value 0.038). It also connects η_2 and η_3 with coefficient value 0.24 (with Z- value 0.091) and η_1 and η_3 with coefficient value 1.9 (with Z- value 0.000). From the results of M3 it can be observed that the values of occupation, having own vehicle, trip purpose, mode of transportation, frequency of ridesharing, ridesharing with unknown person is uncomfortable, changing work schedule to join ridesharing and comfort level influence SQ negatively where educational qualification, income per month, trip distance, schedule of trip, willingness to pay for ridesharing, mind set/habit and interest level influence SQ positively. Although the results of M3 indicates comfort level (coefficient value-0.91; p- value 0.000) is significant but it influences ridesharing SQ negatively; which does not correspond to the actual scenario. If safety is ensured; use the service more is a major variable which is insignificant (0.023; Z- value 0.724) and it influences SQ positively. Values of fit indices (CFI = 0.529, RMSEA = 0.079, SRMR = 0.077) indicates poor fit as CFI value is very low. M3 is not regarded the desired model considering the real situation.

Model M4 introduces a latent variable η_0. Four endogenous variables are employed to develop M4 namely comfort level, safety concern of own and belongings and measures to improve ridesharing depend on latent variable η_0 which is calibrated by ten exogenous variables. After shuffling the variables, the best structure with this layout is found. From the results of M4, income per month, trip purpose, if safety is ensured; use the service more, schedule, willingness to pay for ridesharing, and measures to improve ridesharing influence SQ positively. Result shows that comfort level is the most significant variable (coefficient value 0.47; p value 0.00) followed by if safety is ensured; use the service more, willingness to pay for ridesharing, consider ridesharing for financial savings, scheduling and income per month having coefficient values 0.39, 0.33, 0.27, 0.17 and 0.11 respectively as shown in Table 4.4. Safety is very important variable for ridesharing considering current scenario for Dhaka city. The results of M4 indicates fit indices as (CFI = 0.97, RMSEA = 0.082, SRMR = 0.068). RMSEA value is good and CFI value near to 1.00 indicates good fit.

Table 4.4: Estimated parameter values of ridesharing SQ models

Observed Variables	Estimated Parameters			
	Model 1	Model 2	Model 3	Model 4
Age	_	1[y]	1[y]	_
Gender	_	*0.0041*[y] (0.191)	*0.0038*[y] (0.238)	_
Educational qualification	*0.01*[b] (0.714)	0.058[y] (0.000)	0.061[y] (0.000)	_
Occupation	*-0.0003*[a] (0.986)	-0.14[y] (0.000)	-0.14[y] (0.000)	_
Income per month	*-0.027*[a] (0.336)	0.24[y] (0.000)	0.22[y] (0.000)	0.11[x] (0.002)
Having own vehicle	*-0.044*[a] (0.498)	*0.07*[y] (0.141)	-0.39[y] (0.000)	*0.029*[x] (0.853)
Travel expenditure	0.07[b] (0.032)	*-0.18*[y] (0.129)	1[y]	*0.12*[x] (0.122)
Schedule of trip	-0.041[b] (0.017)	*0.012*[y] (0.571)	*-0.057*[y] (0.619)	_
Trip distance	*-0.0082*[a] (0.757)	*-0.098*[y] (0.169)	0.55[y] (0.000)	_
Trip purpose	_	*0.22*[y] (0.151)	-1.3[y] (0.000)	0.15[x] (0.015)
Mode of trip	*-0.00064*[b]	*0.099*[y] (0.197)	-0.54[y] (0.005)	*0.064*[x] (0.147)

	(0.973)			
Having information about ridesharing	*-0.038* [a] (0.518)	*-0.021* [y] (0.236)	*0.063* [y] (0.319)	_
Waiting time for ridesharing	*-0.04* [b] (0.396)	_	*0.0027* [y] (0.875)	_
Prescheduling	*0.016* [a] (0.635)	_	0.055 [y] (0.070)	0.17 [x] (0.036)
Willingness to pay for ridesharing	*-0.038* [b] (0.304)	_	0.046 [y] (0.000)	0.33 [x] (0.000)
Considering ridesharing for financial savings	_	_	*-0.00031* [y] (0.973)	0.27 [x] (0.000)
Safer mode	_	*-0.069* [y] (0.107)	*0.0034* [y] (0.665)	_
Ridesharing with unknown person is uncomfortable	*-0.036* [a] (0.314)	_	-0.25 [y] (0.000)	_
Mindset/habit	*-0.025* [b] (0.679)	_	0.14 [y] (0.001)	*0.001* [x] (0.994)
Car with GPS	-0.16 [b] (0.017)	_	*0.087* [y] (0.112)	_
If safety is ensured; use more	*0.039* [a] (0.493)	_	*0.023* [y] (0.724)	0.39 [x] (0.008)
Important as it fills service area gaps not filled by public transport	-1.5 [y] (0.059)	*-0.021* [y] (0.490)	*0.0081* [y] (0.945)	*0.018* [y] (0.565)
Comfort level	-0.76 [y] (0.001)	-0.45 [y] (0.000)	-0.91 [y] (0.000)	0.47 [y] (0.000)
Interest level	-0.24 [a] (0.002)	_	0.96 [y] (0.000)	_
Changing work schedule to join ridesharing	*-0.062* [a] (0.248)	_	-0.58 [y] (0.000)	_
Frequency to travel by ridesharing	0.15 [b] (0.000)	_	-1.7 [y] (0.000)	_
Preferred distance to get a ridesharing partner	0.11 [a] (0.034)	_	_	_
Safety concern of own and belongings	0.039 [b] (0.070)	*-0.0086* [y] (0.782)	_	*-0.0075* [y] (0.811)
Ensure guaranteed ride home for improvement	*0.034* [a] (0.106)	-0.045 [y] (0.041)	_	-0.047 [y] (0.033)
Covariance (Important as it fills service area gaps not filled by public transport, comfort level)	*0.033* (0.374)	_	_	_
Covariance (Important as it fills service area gaps not filled by public transport, SQ of ridesharing)	2.4 (0.062)	_	_	_
Covariance (Comfort level, SQ of ridesharing)	0.25 (0.023)	_	_	_
Latent variable η_0	_	_	_	*-0.086* [a](0.664) 0.16 [b](0.05)

				1[c] 0.51[d](0.003)
Latent variable η_1	_	*0.14* [a](0.171) *-0.28* [b](0.136) -0.22 [c](0.076) 0.19 [d](0.055) *0.37* [e](0.142)	_	_
Latent variable η_2	_	0.44 [a](0.074) -0.75 [b](0.036) *-0.55* [c](0.151) *0.45* [d](0.125) 1[e]	_	_
Covariance (η_1,η_2)	_	*-0.10* (0.142)	0.026 (0.038)	_
Covariance (η_1,η_3)	_	_	1.9 (0.000)	_
Covariance (η_2,η_3)	_	_	0.24 (0.091)	_
Z	_	_	*0.0043* [f](0.990) 1[g] *1.9* [h](0.83)	_

Italic numbers indicate 1.00 < Z_ value < 1.64
Italic underline bold numbers indicate Z value < 1
p -values are shown within first braces ().
y indicates endogenous variable
x indicates exogenous variable
a influences importance
b influences comfort level
c influences measures to improve ridesharing
d influences importance
e influences safer mode
f influenced by latent (η_1)
g influenced by latent (η_2)
h influenced by latent (η_3)

Table 4.5: Fit Indices of the SE Models

Fit indices	M1	M2	M3	M4
Absolute fit indices Root Mean Squared Error of Approximation (RMSEA) Standardized Root mean Error of approximation (SRMR)	 0.078 0.028	 0.046 0.035	 0.079 0.077	 0.082 0.068
Incremental fit index Comparative Fit Index (CFI)	 0.576	 0.433	 0. 632	 0.97
Parsimony fit index Akaike's Information Criterion (AIC)	 36904.3	 24140.9	 41367.2	 32512.9

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

At present ridesharing is a major contributor in transportation sector as its exponential rise in popularity day by day. The major findings of this study are summarized in the following section. Some recommendations for the future study are also presented in this chapter.

5.2 Key Findings from Respondents

a. Result shows that most of the respondents (79%) are male age range between 20 to 39 years. About 67% of the users are graduates and post-graduates. Half of the users are full time government/private job holders while most of the users (79%) do not have own vehicles whose main mode of trip is bus/train/tempo.
b. About half (51%) of the respondents spent thousand to five thousand BDT per month as travel expenditure based on their trip distance which is mostly ranges from 5 kilometers to 20 kilometers. The schedules of trip of the passengers are mostly during office hour which is within 7:00 a.m. - 9:00 a.m.
c. According to the result majority (59%) of the respondents know about ridesharing while half (48%) of them state that rideshare is a safe transportation system. Result indicates that majority (48%) of the respondents expect rideshare trip to be prescheduled while most (60%) of them are willing to wait for less than 10 minutes for a ride. About half of the respondents want to share ride as often as possible and willing to pay less than 50 BDT for a shared ride.
d. Majority of the respondents perceive that if safety is ensured, they will use this commute more frequently. The reason for considering rideshare is for financial savings due to shared commuting (41%). 56% of the respondents agree that rideshare is comfortable while half (52%) of them are somewhat interested in ridesharing.

e. 44% of the respondents are willing but would not be able to change their work schedule to join rideshare. Half (49%) of the respondents would like to travel less than 1 kilometer for meeting a rideshare partner. Owing to completely unknown ridesharing partners, majority (42%) of the respondents are concerned about safety of their own and belongings. The respondents rated service quality of ridesharing as good and suggested to have guaranteed ride home for improvement of rideshare services.

5.3 Key Findings Form SEM

a. This research presents the relationship regarding the ridesharing SQ and service variables affecting the SQ in Dhaka city. SEM is employed for representing, estimating, and testing the relationship among measured and latent variables. To obtain the structure that fits ridesharing data of developing countries, four different SE models are developed.
b. For developing SEM total twenty-seven variables were used. Although some of the fit indices of the model are mediocre fit, but the models unveil logical supposition, which suggests the adequacy of the model.
c. This research can demonstrate and confirm the underlying relationship of the service quality of ridesharing service in Dhaka city. This research evaluated passengers' opinion about the service offered by informal ridesharing in Dhaka city. Citizens whom already experienced ridesharing felt that ridesharing is fairly safe as well as comfortable transportation system. From the result it was identified that most of the ridesharing participants are aging from 20 to 39 years. As ridesharing is comparatively expensive than other public transportation services, office going people are the key customers for the service which is similar to the findings of Tao & Wu (2008) and Caulfield (2009); which shows that ridesharing participants were mainly office going people and skilled or non-skilled workers. Majority of the ridesharing users of Dhaka city are male.
d. Respondents prefer prescheduled ridesharing and they are willing to wait for less than 10 minutes for a ride which supports the result of Tao & Wu (2008) as approximately 70% users are willing to pay for ridesharing if maximum waiting time is guaranteed within 10 minutes.

e. The passengers would like to travel less than 1 kilometer for meeting a ridesharing partner. Since the ridesharing partners are completely unknown to each other, passengers are always concerned with the safety of their own and belongings which is identical to the findings of other studies (Furuhata et al., 2013; Chaube et al., 2010; Amey et al., 2011), which found that privacy is a major concern for individuals who are most likely to use ridesharing. Because of shared commuting, ridesharing can save a lot of travel expenses which support the findings of other studies (Agatz et al., 2011).
f. From the results of M4, income per month, trip purpose, if safety is ensured; use the service more, preschedule, willingness to pay for ridesharing, and measures to improve ridesharing influence SQ positively implying that by improving those variables ridesharing SQ may be enhanced. Among the variables comfort level, if safety is ensured; use the service more, and willingness to pay for ridesharing, have influence on ridesharing SQ. Variables of next importance are consider ridesharing for financial savings, prescheduling and income per month. If proper safety is ensured, then more passengers would prefer the service.
g. All the results match with the real scenario quite remarkably. It is important to emphasize that all these significant variables have a decisive role in the perception of improving SQ.
h. The users hardly consider safety concern of own and belongings. Guaranteed ride home should be ensured for improvement of ridesharing. Hence the variables exhibited negative signs in the model results, inferring that they were overlooked in most instances when they were choosing between the different circumstances.
i. The proposed models of customer satisfaction may be used as a basis to plan efforts towards improving the customer satisfaction of ridesharing services. The results of this study present better understanding about the amount the users are willing to pay for ridesharing service since it relates passengers view and interests about it. If safety issues are ensured, then the interest level of women for ridesharing may increase.
j. Rideshare in Dhaka city still is in developing stage. People are not yet confident to choose this mode of transportation. Ride-sharing adds to economic, environmental, and social sustainability in this country. Ride-sharing is widespread in both developed and developing nations like Bangladesh. Ride-sharing firms benefit from new ways to use the

service and make money. In addition to these benefits, ride-sharing services may help reduce congestion and improve travel options for riders.

5.4 Limitations of the Study

Some limitations of this study are appended below:

a. The number of variables is taken only 27. It could be more in practical.
b. This study considered 628 responds of users and 25 responds from the operators.
c. There were not sufficient reliable data on the percentage of population of Dhaka city availing ridesharing services
d. The responds were not very sincere in replying the survey questions.

5.5 Challenges of the Ridesharing and Its Mitigation Measures in Dhaka city

The current challenges related to ridesharing are discussed during the survey time as part of the investigation. A group of ridesharing stakeholders were interviewed, including private rideshare service companies, public service providers, and major organizations. The purpose of these interviews was to gather information from users and operators on the biggest issues they face in this field. The reflection of ridesharing Challenges in Dhaka City are added below:

a. Safety concern of own ,their vehicles and valuable papers
b. Lack of connectivity with other mode of transportation
c. No fixed price assessment
d. Not prescheduled
e. Harassment by law enforcing agencies in the name of checking
f. Facing financial loss for providing special discount on fare by ridesharing company

Mitigation Measures

Some Concepts of mitigation measures should inevitably turn on such as the following:

a. Help to establish ridesharing with vehicles of different agencies

b. Provide parking for ridesharing
c. Provide guaranteed ride home
d. Provide rideshare matching
e. Subsidize ridesharing fares
f. Market ridesharing to business/to transit riders

5.6 Ridesharing Prospects within Dhaka City

From the user's perspective, rideshare is the most convenient and friendly mode of transportation which is more time saving and cost-efficient than those traditional transportations. The other ridesharing prospects are appended below:

a. A new mode of transportation has come up.
b. Increasing employment opportunities.
c. Reducing traffic jam and road congestions.
d. Encouraging foreign ridesharing companies to invest

5.7 Recommendations for Future Research

Few recommendations for further study are given below:

a. In future study, during questionnaire survey- it should be questioned to the respondent to select the most five important variables that have great impact on challenges of ridesharing. Then after model analysis, it should be examined whether those variables are important factors or not.
b. This study considers ridesharing services only for Dhaka city. For the development of the ridesharing service, however, the assessment must consider other cities in Bangladesh.
c. The long-term behavior of the user's attitude, demand, and experience with ridesharing services can be incorporated in future research.
d. In Dhaka city, the reasons why females are more hesitant to share a vehicle than males

should be examined. To improve ridesharing service quality, future study should take into account the preferences of the elderly, children, and disabled individuals.

e. The numbers of respondents should be increased.

The study findings can be utilized by the city transportation authority of Bangladesh to improve the overall ridesharing services to attract the new passengers as well as to retain the current ones. If more opportunities can be provided in this sector, ride sharing will become one of the best options for the residents of Dhaka city.

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Appendix

Questionnaire-Rideshare

Demography

1. Passengers Identity

a. Name :_____ b. Age _____Years

c. Gender: 1. Male 2. Female

d. Home Address(Town Only):_____

2. Occupation:

a. Govt. Job

b. Pvt. Job

c. Business

d. Student

e. Other

3. Income

a. Less than 5000
b. 5000 -10000
c. 10000-20000
d. 20000-40000
e. More then 40000

4. Do you have own vehicle?

a. Yes

b. No

c. Yes, But given for rent

Trip Characteristic

5. What is the monthly household travel Expenses?

a. Less than 1000
b. 1000-3000
c. 3000-5000
d. 5000-10000
e. Above 10000

6. Schedule of Trip? _____ A.M. /_____P.M.

7. Trip Route

a.Origin:_____

b.Destination:_____

8. Trip Distance (Approx)

a. Less than 5 km.

b. 5 km. - 10km.

c. 10 km.-20 km.

d. More than 20 km.

9. How much do you pay for Rideshare/Carpool (within Dhaka City)?
(**Note: Cost per km. Tk**.....)

a. less than 50 tk.

b. 50 tk. – 100 tk.

c. 100 tk. – 150 tk. c.

d. 150 tk. – 200 tk.

e. More than 200 tk.

10.Trip purpose :

a. Office/Business

b. Education

c. Recreation/Shopping/Medical

d. Others

11. What is the Mode of Transportation?

a. bus/train/tempo
b. private car
c. taxi
d. motor cycle
e. bi-cycle/rikshaw
f. walk

Rideshare

12.Do You Know about Ridesharing or Carpooling?

a. Yes
b. No

Note: **Ridesharing or Carpooling is defined as two or more persons sharing their daily commute on a regular basis.**

13. How long did you wait for a Ride?

a. Less than 10 minutes
b. 10-20 minutes
c. 20-30 minutes
d. more than 30 minutes

14. Was it a prescheduled Trip?

a. yes

b. no

c. sometimes

15. Why should you consider Ridesharing?

a. Do not have own car/ for comfortable trip

b. Financial savings due to shared commuting

c. Deceased personal vehicle maintenance, wear and tear

d. For safe trip

e. Others (please mention)_____

Safety/Comfort

16. Do you think rideshare is a safer mode of transportation?

a. yes

b. no

c. sometimes

17. What will be your level of comfort during Rideshare?

a. Very Comfortable
b. Comfortable
c. Not so comfortable
d. Uncomfortable

18. What is your view towards rideshare?

a. Rideshare with unknown person uncomfortable

b. It's a matter of mindset.

c. It's a matter of habit.

d. If Drivers are profession with good background and car can monitor by GPS, It will be comfortable.

e. If safety is ensured, will use this commute.

19. Please describe your interest level in rideshare/carpooling.

a. Not interested

b. Somewhat interested

c. Very interested

20. Why ridesharing is important?

a. Environmental concerns

b. Market demand from customers

c. Service area gaps not filled by existing transit service

d. Improved access to public transit routes, businesses and services with limited parking

e. Other (please specify)

21. Are you willing and able to change your work schedule to join a rideshare?

a. Yes, I am willing and able

b. I am willing, but not able

c. I do not have an interest in changing my schedule to join a rideshare/carpool

22. How frequently would you like to rideshare/carpool?

a. As often as possible (every day)

b. 3-4 times per week

c. 1-2 times per week

d. 2-3 times every 2 weeks

e. Only occasionally

f. I am not interested in carpooling

23. How far would you travel to meet a rideshare partner(s)?

a. Less than 1 kilometer

b. 1-2 kilometer

c. 2-3 kilometers

d. More than 3 kilometers

Service Quality

25. What do think about the service quality of Rideshare?

a. Satisfactory

b. Good

c. Very Good

d. Excellent

26. What is the Limitations of Rideshare?

a. Safety concern of own and belongings

b. Connectivity with other mode

c. No fixed price assessment

d. It is not prescheduled

e. Others (please mention)

Improvement:

27. What may be done for improvement of rideshare/carpool?

a. Provide rideshare/carpool matching

b. Help establish ridesharing/carpools with vehicles of different agency

c. Provide parking for ridesharing/carpools

d. Provide guaranteed ride home

e. Subsidize ridesharing fares

f. Market ridesharing to businesses/to transit riders

g. Provide incentives (e.g., loyalty programs, Commuter Checks, prizes, recognition)

h. Other (please specify)