

Identifying And Quantifying The Factors Influencing Mode Choice Behavior For Supply Chain Implications: Evidence From Dhaka, Bangladesh

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ABSTRACT

It can be said that a city is much developed if its urban planning for roads and highways is good enough. The metro city of Bangladesh is well developed in terms of roads and highway planning but for the reason of overpopulation, it seems incomplete. This study shows that the Supply Chain of ride sharing companies in Dhaka region have to work further to gain the ultimate satisfaction of customers. In 2016, first ride sharing started in Dhaka city with BIKE. In recent years, many companies stepped in this sector and gave the people more options to select the transportation modes. The focus of this study was to show the factors influence behind choosing various transportation modes based on some criteria. People actually want to move from one place to another in short time within a reasonable transport fare. On the other hand, they also do not want to stick in traffic jam. For that reason, if they have to pay more fare they will. Diverse set of occupational people tends to lean on CAR and BIKE because they try to drop customer on time. The popularity of some transports decreased over the years. Besides, people became more dependent on BUS. The supply Chain of the ride sharing services must focus in not only BIKE and CAR but also BUS and CNG, which are also a potential area to develop the service and become more reliable to meet the customer demand and satisfaction.

1. INTRODUCTION

Dhaka is the capital of Bangladesh. In terms of politics, culture, economy and education it plays a vital role in the life of people. Every administrative and economic decisions are done here. All people living inside and outside Dhaka, they want the best facilities for their families and themselves. They are settled in Dhaka and that causes a population increase. The population of Dhaka city (areas under the jurisdiction of the Dhaka city corporation) stands at approximately 21,005,860 (“Dhaka Population 2020 (Demographics, Maps, Graphs),” n.d.). The population is growing by an estimated 4.2% per annum, one of the highest rates in amongst Asian cities. Due to over growth of population transportation problem has become major obstacle in the Dhaka city; moving from one place to another has now become more difficult for the inhabitants of the mega city (Islam, Uddin, & Rahman, 2020). According to the World Bank, average traffic speed in Dhaka has dropped from 21 km/hour to 6.4 km/hour over the last ten years (“A Modern Dhaka is Key to Bangladesh’s Upper-Middle Income Country Vision,” n.d.). For planning of public transport, mode choice behavior is one of the crucial portions. This is because of the key role played by public transport in policy constructing (Anagnostopoulos, 2012). A mode choice or mode split model is concerned with the excursion maker’s behavior regarding the selection of travel mode (“Transportation Engineering and Planning by C S Papacostas, P D Prevedouros,” n.d.). People can select different travel modes in different situations.

Transport has also a supply chain network. Nowadays there are many rides sharing company or individuals who are providing this transport service to the people of Dhaka. Mode choice behavior acts huge role in implementing sustainable supply chain framework (Jazairy, 2019). The study attempts to find out the factors, which are influencing people to choose the transport mode and how it is creating impact overall supply chain network. The primary purpose of any supply chain is to satisfy customer needs (“ The Impact of Supply Chain Management on Customer Service (A Case Study of Lebanon),” n.d.). To satisfy customer, it is important to know about the factors, which influence them to choose their transport(Chee & Fernandez, 2013). To the critical relationship between transportation infrastructure, freight traffic, economic market drivers, and regional economic development is the main agenda of the investigation.

2. LITERATURE REVIEW

This section presents brief overview on mode service in Dhaka along with factors affecting mode choice behavior of inhabitants in Dhaka and its association with supply chain.

2.1 DHAKA AND ITS TRANSPORTATION SERVICES

Dhaka is the capital and economic hub of Bangladesh, one of the fastest growing economic cities of the world. Since winning their liberation from Pakistan back in 1971, for the first time they recorded a higher GDP per person than Pakistan in 2017. Converted into dollars at market exchange rates, it was \$1,538 in the past fiscal year whereas Pakistan's was about \$1,470 ("East overtakes west - Bangladesh's GDP per person is now higher than Pakistan's | Asia | The Economist," n.d.). Today some economist says that Bangladesh will be the next Asian tiger. Its growth rate in year 2018 was (7.8%) put it at par with India (8%) and well above Pakistan (5.8%)(“By choosing development over militarism, Bangladesh has rapidly overtaken Pakistan,” n.d.). While this tremendous growth brings up many business opportunities, it also puts a lot of stress on the limited resources of the country. While the economy suddenly shifted from agriculture to industrial sectors, more people came to Dhaka from other parts of the country in search of jobs (“A tech revolution helps boost Bangladesh's development,” n.d.). Dhaka is the seventh most populated city in the world (“Dhaka Population 2020 (Demographics, Maps, Graphs),” n.d.). According to the World Bank, average traffic speed in Dhaka has dropped from 21 km/hour to 6.4 km/hour over the last ten years (“A Modern Dhaka is Key to Bangladesh's Upper-Middle Income Country Vision,” n.d.).

Sustainability of transport system depends on a range of services and impacts produced by transport, which can be indicated by several factors like mode choice, affordability, use, equity, accessibility, pollution, safety, integrity, and efficiency (Litman & Burwell, 2006). According to European Council of Ministers of Transport (2004), a sustainable transportation system is one that allows the basic needs in a safe and consistent manner considering human and system health with equity within and between groups (“Sustainability of Carsharing Service in Dhaka: A Case Study on Uber Users,” n.d.). The choice of walking, cycling, other non-motorized modes, public transport, car sharing can determination the system towards sustainability (GNBF, 2010).

In Dhaka city, more than 45% of the total trips are generated by motorized automobiles like car, motor, cycle, taxi, minibus, truck etc.(“Can BRT solve the transport crisis in Dhaka city?,” n.d.). In 2015, 54,800 motor vehicles were sold in which 28,500 were passenger cars. That

means 78 cars were sold per day in 2015 (“World Motor Vehicle Sales by Country and Type - knoema.com,” n.d.). The rate of buying cars are increasing day by day. This is increasing the traffic congestion in Dhaka. Ride sharing company like Uber, Pathao, Shohoj, Obhai and others, who provide ridesharing services have become very popular in Dhaka. When people are getting used to these ridesharing services, some other mode is not used. As if people have reduced rickshaw using because they can go in these ridesharing services in terms of time efficiency, same cost, comfort etc.

2.2 MODE CHOICE

One of the most important classic models in transport planning is the choice of transport. This is because of the key role played by public transport in policymaking (Anagnostopoulos, 2012). People can select a mode between different travel modes in a typical travel situation. These could be driving, using public transport like bus or rail, walking, riding motorcycle or riding with someone else by sharing a bike. A mode choice or mode split model is concerned with the trip maker’s actions concerning the selection of travel mode (“Transportation Engineering and Planning by C S Papacostas, P D Prevedouros,” n.d.). The philosophy behind mode choice model is to effectively manage the transportation demand and be able to provide for these demands by making alterations in the standing system (Minal & chalumuri, 2014).

2.3 FACTORS AFFECTING MODE CHOICE

Traveler characteristics is subjected to the selection of the transportation mainly it is diverged by age. Comparatively young aged consumer used to go on short distance location as the age. It is debatable that the age effect could be related to minor number of commercial trips. In the oldest group publics, consuming higher income usages personal vehicle (Lim et al., 2017).

The relationship between age and travel behavior is multi-faceted. Young person, for instance, are far less likely than adults to make any type of free trips are. Teenagers on the other hand, want to travel anywhere and everywhere without and specific plan, they probably need a reason to get out of their homes. Adults tend to travel out for necessity or for recreational purposes. Older people have the desire to walk or bicycle and spare their time in a qualitative way, but there might be physical constraints. Hence, attitude towards specific modes also varies generationally, with older generations more familiar with, if not inclined towards transit (Reilly & Landis, n.d.).

Relationship between gender and travel behavior is also a major factor that determines the mode choice. What may be true for some men and women may or may not be true for the others. Many women than men, for example, are less willing to take up trips or take modes as

they perceive them as unsafe. There are also incidents of memory biases in terms of seeing or hearing something extremely unpleasant, that might restrict women from taking public transport.

In addition, clothing of women, in different cultures can affect a lot on the choice of transport. Hence it is important to keep in mind the gender related issues as well, such as transport and street infrastructure to ensure women's high user group and make them as comfortable as it can be.

Women are more likely to use public transit than men are. Meanwhile, substitution effects exist among various travel modes. For a specific mode, men's mode choice is not so easy to be affected by other travel modes as women's (Yang, Li, Wang, Zhao, & Chen, 2013).

Employed people might have greater demands on their time and thus, prefer quicker and more convenient modes of transportation, as private car, compared to slower or less convenient modes. In addition, the location of their work places has a great impact on the mode choice and again the affordability and time compared to their income is a strong determinant of the same. Home income, or when normalized to family sized household income per person, has a strong impact on the mode choice (Reilly & Landis, n.d.). Upper-income households and persons are thought to place a higher value on the comfort and convenience associated with the private auto, particularly for non-work trips. Ownership of the vehicles and the access to license also plays a major role in travel behavior, regardless of what the purpose of the trip is. There was an observation that the rich in the city travel more as compared to the poor. The poor ones would always like to stay nearer to their workplaces and reduce their travel costs, which is very unlikely in the case of the rich ones. They would live far away from their workplaces, and drive to their workplaces. In addition, sometimes when the poor use the public transportations, access to it is another major issue, as because, still in many places the feeder services are not that strong and expensive also if compared to what a normal poor person can afford for travel (Daniels & Mulley, 2012)

Hence, the travel behavior and mode choice are very well reflected upon by the income factor. In the case of Dhaka, mostly private automobiles use petrol and CNG as a medium of energy source and public buses mostly use diesel and CNG. These are major sources of carbon dioxide emission and affects the sustainability of the environment. (" A Study on Mode Choice Behaviour of Working Population in Dhaka: A way towards Sustainable Transportation," n.d.)

Some main reasons are responsible for short distance travels such as carrying heavy goods, shortage of time, and convenience (Mackett & Brown, 2011). Most significant action to reduce the number of car trips is to improve public transit

Compared with time and cost variables to models with time, cost and convenience variables and discovered that descriptive power of the second mode-choice model is significantly stronger (Barff, Mackay, & Olshavsky, 1982).

2.4 MODE CHOICE BEHAVIOR AND ITS EFFECTS IN SUPPLY CHAIN STAGES

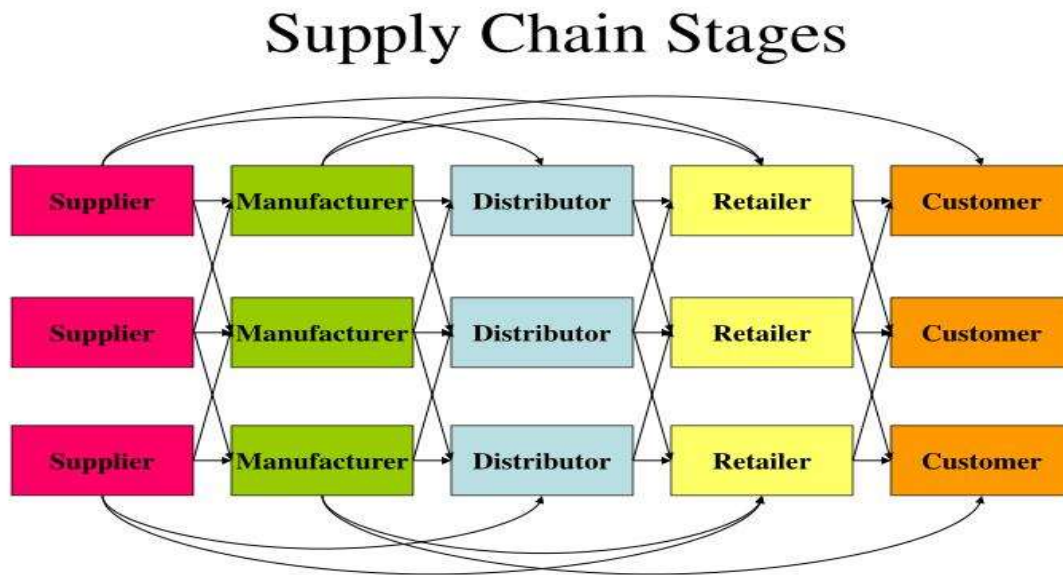


Fig.01: Supply Chain Stages (Chopra et al., 2013)

From the stages of supply chain, it is so obvious that the main agenda of a supply chain network is to fulfill customer's requirements (Stock, Boyer, & Harmon, 2010). From the supplier or service provider a strong network required to reach the customer including Manufacturer, Distributor, and Retailer etc (Mabert & Venkataramanan, 1998; "Special Research Focus on Supply Chain Linkages: Challenges for Design and Management in the 21st Century* | Request ,," n.d.). Mode choice behavior of customer is solidly related with supply chain network (Meixell & Norbis, 2008). Supplier, Manufacturer, Distributor, Retailer and Customer are linked with each other in a successful supply chain network (Chopra et al., 2013)

In order to create perfect liaison between the stages of supply chain network customer mode choice of behavior is obligatory (Zanjirani Farahani, Asgari, & Davarzani, 2009)

For implementing sustainable supply chain, network its required to know the mode choice of behavior of supply chain. Without customer fulfilment, execution of good supply chain network is almost impossible. As the customer plays key role in the supply chain so, it is required to study the customer's behavior choices (Fan & Zhang, 2016)

3. OBJECTIVES

The core objectives of this study are

1. To identify and quantify the factors influencing mode choice behavior of inhabitants of Dhaka
2. To understand the implications of mode choice behavior in supply chain management

4. METHODOLOGY

As the main purpose of this study is to find out the vital factors behind selecting the transportation modes of the users in Dhaka region, we did surveys on some segmented population as such based-on gender, occupation, age. The outcomes of the surveys were insightful that how the people choose the transportation mode on basis of different aspects. Besides, the result also showed that what kind of behavioral pattern the people show.

The goal of the research is designed to minimize the number of assumptions and ensure the entire approaches are scientifically sound.

4.1 STUDY AREA

Our focused area is Dhaka city, one of the most populated cities on the earth. The current metro area population of Dhaka in 2020 is 21,006,000, also 3.56% population increased from 2019. People from all over the country migrate to this city for better job, study and other business purposes. Being an over populated city, the roads and routes have been insufficient for the citizens to move throughout this city. Traffic jam has killed numerous amounts of time. In monsoon, the roads of the city lay under the water. This creates too many problems for the students and industrial workers.

Approximately 75% of the passengers of the public transport confronting various problems. Mainly the major portion of the population uses bus and train; other uses the CNG. There are some rides sharing services available in this mega city. People sometimes tend to avoid them due to the high rate. In following years, metro rail will be available for the people.



Fig.02: Dhaka City Route Map

4.2 STRUCTURED QUESTIONNAIRE SURVEY

For doing this research we had set some structured questions using Google doc forms to get the preferences of the people to understand the behavior that how they select transportation modes. We mainly focused on gender, occupation, safety, and comfort and arriving attitude.

For the convenience, we had preset four transportations in those questions. The transportations were BUS, CAR, BIKE and CNG.

For understanding the pattern, the questions were not given as just multiple choices. The questions were set as first preference, second preference, third preference and fourth preference. They selected the preferences based on their priority.

4.3 SAMPLE SIZE

We surveyed over 110 persons. Their feedback was quite interesting and they were from diverse professions.

Table.01: Data Collected from Survey

	Female	Male
Student	21	56
Job Holder	5	21
Businessman	0	7

4.4 DATA ANALYSIS

This portion was done using two data analysis software.

IBM SPSS v25.0

Microsoft Excel v2010

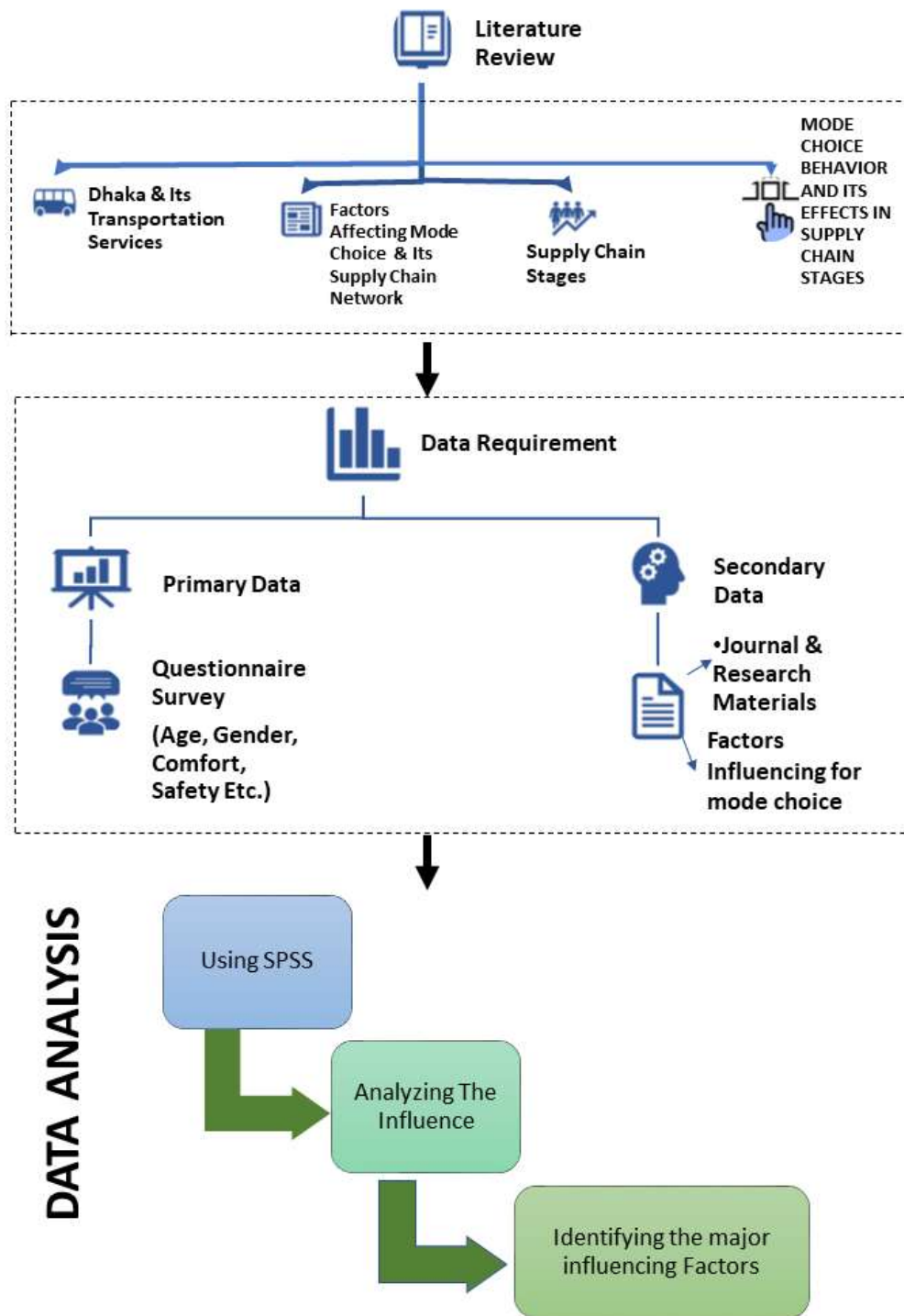


Fig.03: Working Procedure Flow Diagram

In this section, we analyzed the acquired data. Our data analysis approach was based on the questionnaires and we tried to establish a relationship among an individual choose a daily transport considering the gender, occupation, comfort, safety, travel cost, distance and time management.

Using the SPSS software at first, we sorted the age, gender and occupation. Then their preferences they selected as their priority from the given options of transports.

After that, the highest values of each preference were taken and we made a hypothetical relation as such that, 12 females choose bus as their daily traveling transport mode and 47 males choose bus as their daily traveling transport mode as well. Among them female students were 10 and jobholders were two people. Among the male persons, students were 30 and jobholders were 17. From, the values we can see that the tendency of students to ride bus is high and no businessperson uses bus as their daily traveling transport mode.

5. RESULT & DISCUSSION

In this part of the study, we will describe the results we got from the data analysis by IBM SPSS software and alongside will discuss about the projection of the transportation mode selection behavior of the people.

We considered some factors to see the pattern henceforth to get the results. Those factors are:

1. For daily traveling
2. Distant traveling
3. In terms of comfort
4. In terms of safety
5. In terms of expenses
6. Arrival attitude

5.1 FOR DAILY TRAVELING

We made a question regarding this factor and we took the highest responses to see the result.

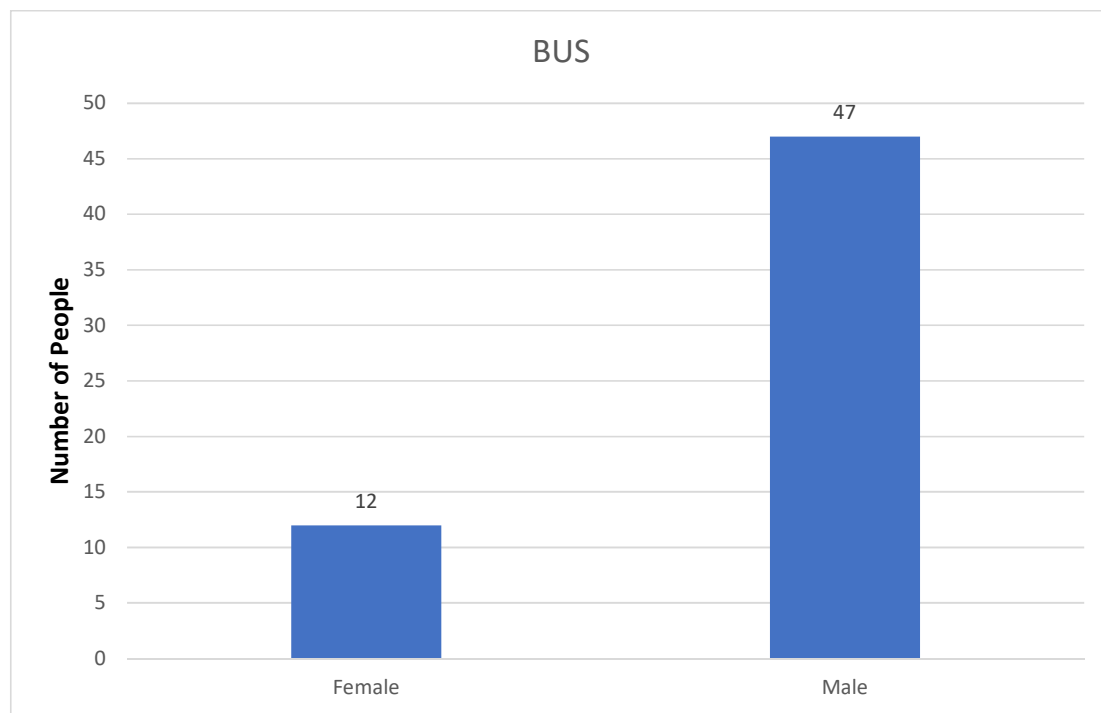


Fig.04: Population Chooses BUS for Daily Traveling (Based on Gender)

Here, the graph depicts that the females and males select Bus as their highest preference among four preferences. Another thing is that total female and male numbers are as following 26 and

84. Among them based on gender 12 females and 47 males, choose BUS as their daily traveling transport mode.

Table.02: Transportation Mode Selection Based on Occupation

Occupation	BUS	CAR	BIKE	CNG
Student	49	7	17	4
Job Holder	7	9	8	2
Businessman	3	3	1	0
Total	59	19	26	6

This Table.02 shows that diverse occupation holders selected BUS as their first and highest priority. However, among other transports BIKE is also popular among students. Henceforth, for daily traveling both the gender and occupation wise BUS was their ultimate selection.

5.2 DISTANT TRAVELING

In this factor, we focused on how the people select transportation modes in terms of distances.

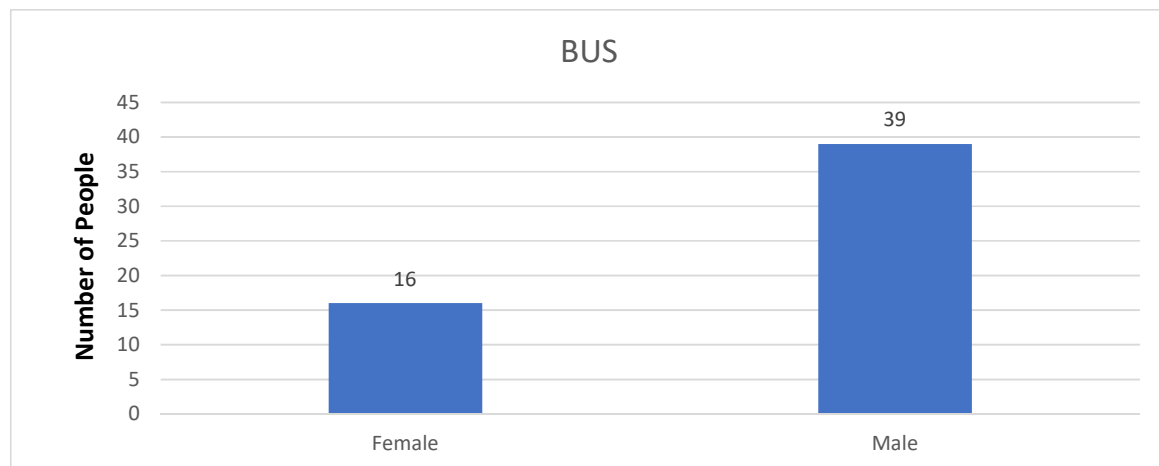


Fig.05: Transportation Mode for 3-5 Km Distance (Based on Gender)

Distance is a great factor for selecting any transportation mode. Based on gender both females and males choose BUS for 3-5 Km distance.

Table.03: Transportation Mode for 3-5 Km Distance (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	48	7	20	2
Job Holder	6	2	14	4
Businessman	1	2	3	1
Total	55	11	37	7

Total 55 female and male choose BUS for their 3-5 Km distance traveling and among them from the Table.03 the occupation shows which segment choose BUS individually. Interesting part is that here also BIKE increasingly becomes popular among the three occupations.

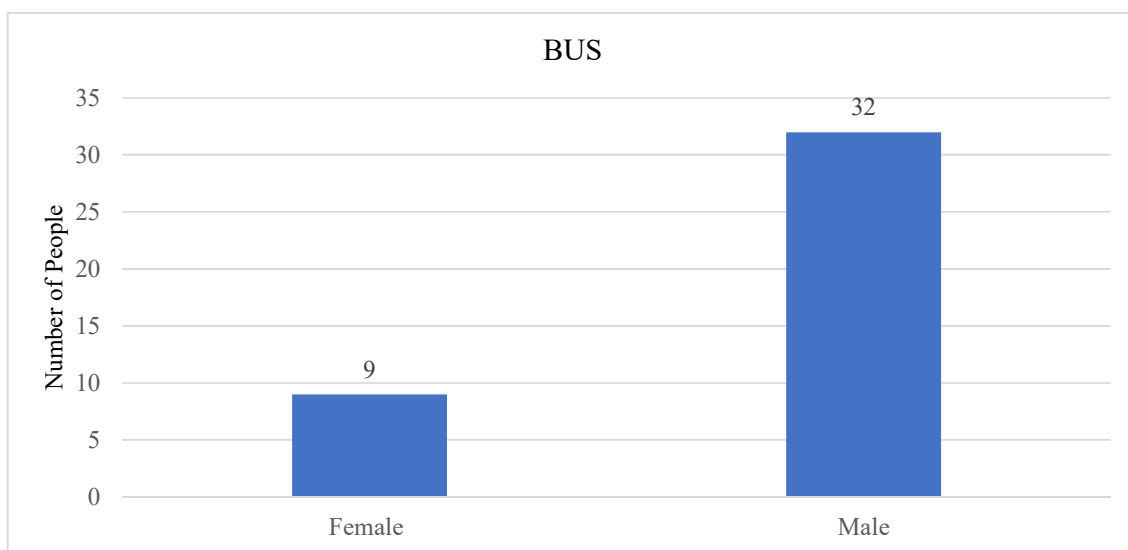


Fig.06: Transportation Mode for 6-15 Km Distance (Based on Gender)

Table.04: Transportation Mode for 6-15 Km Distance (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	34	15	23	5
Job Holder	5	12	6	3
Businessman	2	2	2	1
Total	41	29	31	9

From analyzed data, we found that total 41 male and female choose BUS for their 6-15 Km traveling distance. Table.04 explains this fact by occupation. BIKE users remain second though the distance has been increased. Student uses BIKE more than other occupation.

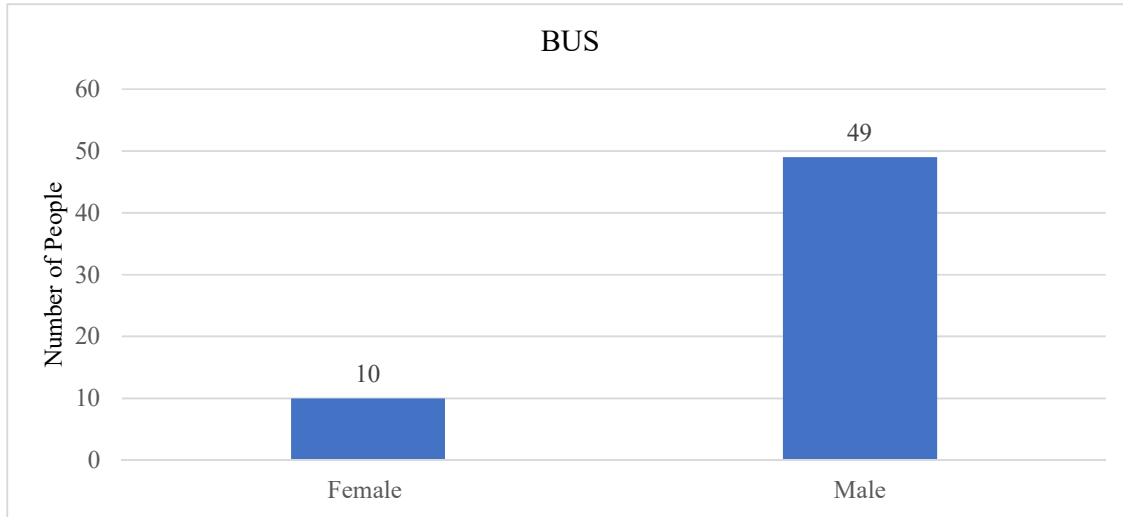


Fig.07: Transportation Mode for 16-30 Km Distance (Based on Gender)

Table.05: Transportation Mode for 16-30 Km Distance (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	44	22	9	2
Job Holder	12	11	2	1
Businessman	3	2	1	1
Total	59	35	12	4

From analyzed data, we found that total 59 male and female choose BUS for their 16-30 Km traveling distance. However, the number of females is decreased as the travel distance has increased Table.05 explains this fact by occupation. BIKE users remain second though the distance has been increased. Student uses BIKE more than other occupation.

5.3 IN TERMS OF COMFORT

Most of the time comfort steps up while traveling whether it is a short travel or long travel.

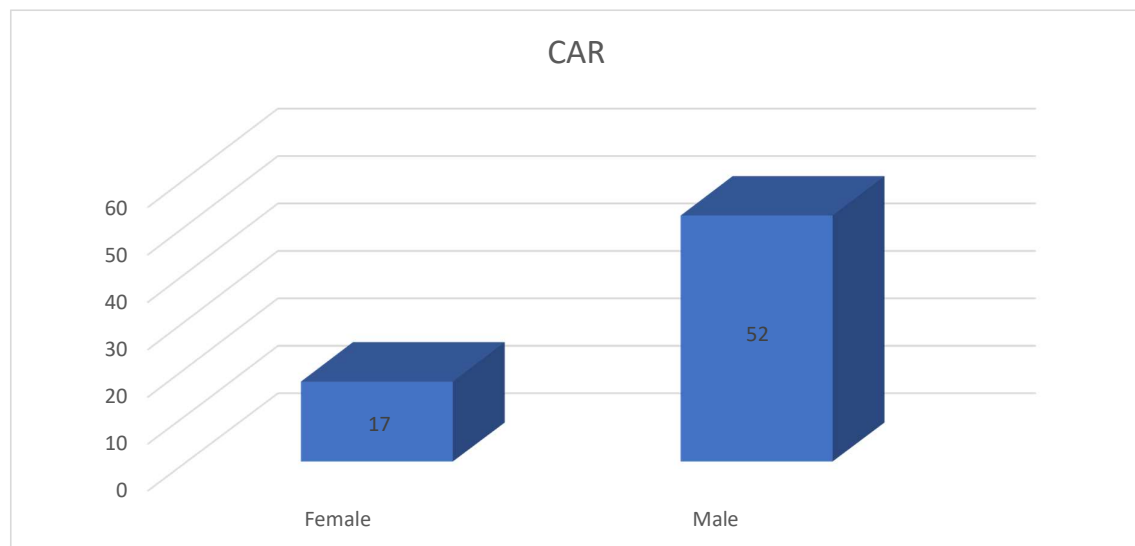


Fig.08: Transportation Mode in Terms of Comfort (Based on Gender)

In terms of comfort, both the genders preferred CAR to any other transport. The reason is in Dhaka city traffic jam kills time and makes so much body ache. Especially females suffer a lot because of this.

Table.06: Transportation Mode in Terms of Comfort (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	14	44	11	8
Job Holder	3	20	1	2
Businessman	2	5	0	0
Total	19	69	12	10

Here, we can see that students are more likely prefer CAR and the other two occupation segments also. This scenario describes that in Dhaka city for comfort any other transport is not suitable. Anyhow, in the second position we can see that few people see BUS as their comfort zone.

5.4 IN TERMS OF SAFETY

As safety is a vital issue while traveling, Dhaka city is wildly crowded and frequently news comes of robbery and various accidents.

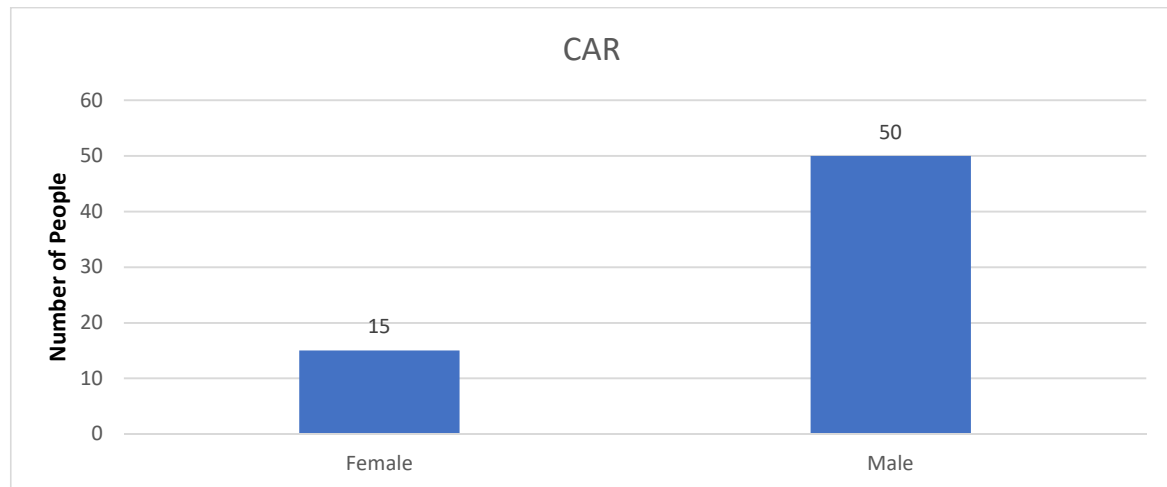


Fig.09: Transportation Mode in Terms of Safety (Based on Gender)

For safety, purpose among 26 females 15 chooses CAR and among 86 males 50 chooses CAR. There remain many issues for choosing CAR as their first priority in terms of safety. In the following table, the data will show descriptive scenario about occupational people.

Table.07: Transportation Mode in Terms of Safety (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	31	41	3	2
Job Holder	6	19	1	0
Businessman	2	5	0	0
Total	39	65	4	2

Highest selected modes were CAR and then BUS. People of Dhaka city find CAR as their comfort zone because of various reasons not only the traffic jam but also robbery, bad road condition and so on.

5.5 IN TERMS OF EXPENSES

Transport expenses play a vital role on the economy. Because of expenses, people change their transportation mode pattern.

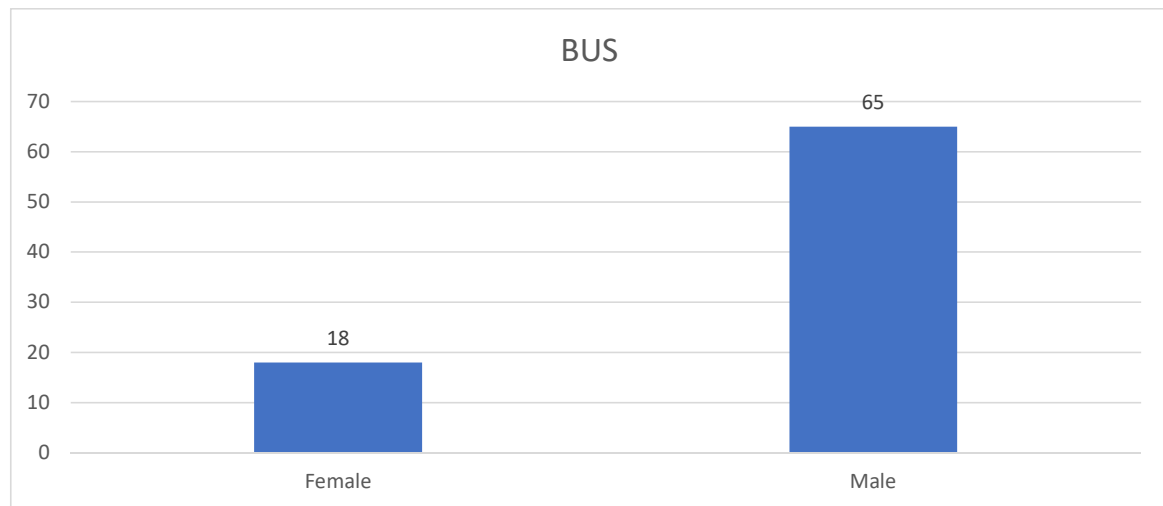


Fig.10: Transportation Mode in Terms of Expense (Based on Gender)

BUS is a kind of transport that is lowest of price for traveling wherever people go. This is the prime reason for choosing the BUS to save traveling cost. Between the both genders, they chose BUS over other three transportation modes.

Table.08: Transportation Mode in Terms of Expense (Based on Occupation)

Occupation	BUS	CAR	BIKE	CNG
Student	55	9	5	8
Job Holder	21	2	3	0
Businessman	7	0	0	0
Total	83	11	8	8

As previously mentioned, here we can see that both the females and males from diverse occupation selected BUS as their ultimate transportation mode for daily traveling. Apart from other issues, BUS is generally considered the common people's ride.

5.6 ARRIVAL ATTITUDE

The human being has different tendencies about arriving somewhere. For example, some arrives early at the work place, some arrives on time and some arrives late. Their attitude determines the transportation mode.

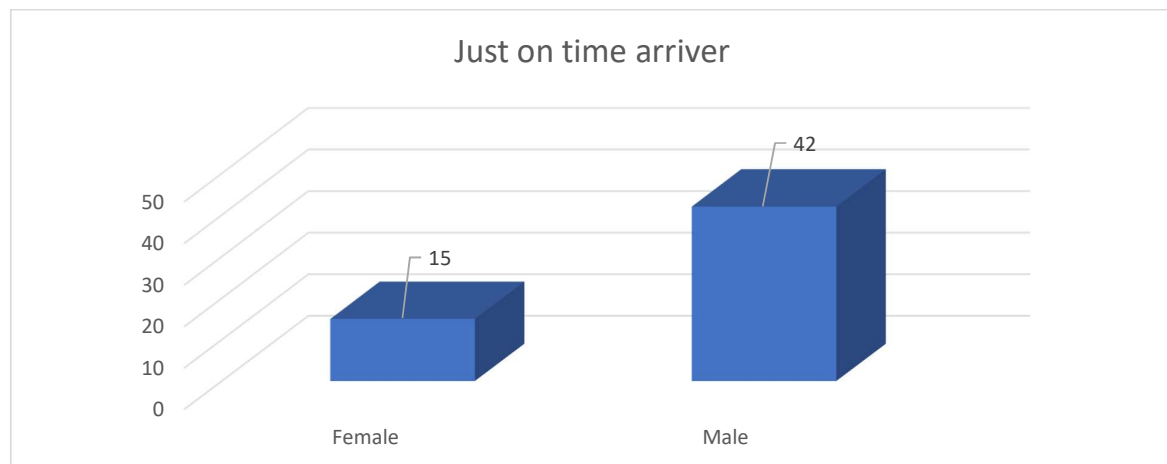


Fig.11: Arriving Attitude (based on gender)

From the graph, it shows that people arrive just on time and the graph shows the attitude pattern that among 110 people 57 people arrives on time.

Table.09: Arrival Attitude (Based on Occupation)

Occupation	EARLY ARRIVER	JUST ON TIME ARRIVER	LATE ARRIVER
Student	23	43	11
Job Holder	13	11	2
Businessman	3	3	1
Total	39	57	14

Arriver attitude affects transportation modes selection. Here, we can see that from diverse set of people the majority arrive on time. As they arrive on time, they surely focus on time management and transportation. The previous tables and graphs determine the pattern of the highest frequency of transportation mode used for daily traveling. The pattern will be described in the following discussion part.

5.7 DISCUSSION

Dhaka city is one of the most densely populated cities in the world and the population is growing by an estimated 4.2% per annum, one of the highest rates amongst Asian cities.

Based on our questionnaire survey, we previously noted some factors, which influence transportation mode choice behavior. Then, the population (110 persons) responded to our survey and they showed a pattern of choosing daily transportation modes.

Overall projection we got that is, people tend to arrive just on time at their work place. They mainly choose BUS as their daily transport and sometimes who doesn't pay heed to money factor, they consider CAR as their daily transportation mode. Another thing is that in Dhaka city BIKE became popular in few years. The young people are more likely to take BIKE as their daily riding mode. On the other hand, CNG had been going through a downfall in contrast with CAR and BIKE. The main reason is both the CAR and BIKE seems more affordable and comfortable than CNG. Here we used more affordable because the ride sharing companies give promotional offers to attract the people and afterwards, they include those offers with the final bill.

The main two needs of customers are quality and affordable price. In Dhaka, city traffic jam is the ultimate problem and the transport fare rise high during those times and pick hour. People want to reach safely, comfortably, with reasonable transport fare and within time. In aspect of Supply Chain of transport in Dhaka city, many ride-sharing companies have grown in recent years. BANGLADESH ROAD TRANSPORT AUTHORITY (BRTA) approved 12 ride-sharing companies. Those are Pick Me Ltd., Computer Network System Ltd., Akash Technologies Ltd., Obhai Solutions Ltd., Chaldaal Ltd., Pathao Ltd., Easier Technologies Ltd., Sejesto Ltd., Shohoz Ltd., Uber Bangladesh Ltd., Buddy Ltd., Akiz Online Ltd.

Every ride sharing companies follow identical Supply Chain Network and they have their own individual strategy. However, if they dig deeper to know what customers want from them, they can focus on this type of study from where they can know what satisfies customer, which factors affect the Supply Chain most, what are the things that can be improved to be a better ride sharing company. Hence, customer satisfaction is the ultimate desire in any Supply Chain Network.

6. CONCLUSION

To conclude, transport is one of the significant drivers among supply chain six drivers. Our concentration was to detect the pattern how people choose transportation for their day to day traveling. Most of the people choose BUS for daily traveling, to reduce cost and for distant places. In terms of comfort and safety, CAR was their most desired transport. However, most important part is that BIKE was always the second priority for the maximum inhabitants who has been surveyed for the study.

The companies which are incorporated with ride sharing company this survey-based study will be beneficial for them. They can observe the overall pattern and come forward with innovative path to develop many vital components to improve customer satisfaction and better service quality.

This particular field can create more opportunities for the new researchers as our study will be advantageous for them.

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