Impact of Shared Mobility on Travel Pattern in Urban Areas

Case Study New Delhi

Manish Kumar Roy
SPA Delhi

Dr. Sanjay Gupta
Professor, Transport Planning Department , SPA Delhi

11th Urban Mobility India Conference & Expo 2018

INSTITUTE OF URBAN TRANSPORT (INDIA)

STRUCTURE OF PRESENTATION

INTRODUCTION

Background of the Study

- In the last **15 years (2000-2015), 20 million cars** have been added in comparison to **7 million cars over first five decades** since Independence (1951–2000). (**Source :**Ministry of Road Transport and Highways – Taxi Policy Guidelines, 2016)
- The total number of vehicles continues to grow in the capital, crossing the 10-million mark. Total number of vehicles on Delhi's streets **increased from 9.7 million in 2015-16 to 10.4 million in 2016-17**

Year	Taxies	Growth Rate
2013-14	74,758	4.72%
2014-15	79,606	6.48%
2015-16	91,073	14.40%
2016-17	1,48,434	62.98%

Source : Economic Survey of Delhi 2014-2015
Delhi Statistical Hand Book, 2017

- Prior to 2014-15, the rise in number of taxis was usually in the range of **5-10% as only 'black and yellow' cabs** or a handful of private cab companies added vehicles to their fleet
- For 2014-2015 ,after Good Vehicles & motorcycles and Scooters, **Taxi has the third largest growth rate i.e. 6.48 %**
- The number of taxis registered in Delhi rose from **79,606** in **2014-15** to **148,434 in 2016-17**, a rise **of 86.4%,** according to the 'Delhi Statistical Hand Book, 2017
- In **2015-16,** the number of taxis on Delhi roads was **91,073,** which means the number grew by around **62.98% in 2016-17** in comparison to the previous year
- Ride-sourcing and car-sharing are two disruptive transportation services whose adoption, use, and impacts in the marketplace remain poorly understood despite their proliferation.

Need of the Study

- **Indian Shared mobility industry** is undergoing a phenomenal change in the recent past, which has **revolutionized the way of travel,** happens in cities, and **very limited empirical work has been done on India**

Aim of the Study

"To study the Impact of Shared Mobility on Travel Pattern in Urban areas "

Objectives of the Study

1. To Appreciate the **importance of Shared Mobility** services in urban areas & **identify issues** affecting its provision and user
2. To review **the Best Global Practices** of shared mobility services & **identify lesson learnt**
3. To assess the **characteristics** of the shared mobility services for Services provider and users in **Delhi & identify issues** affecting the **performances**
4. To evolve the **alternative strategies** for improving the ecosystem of shared mobility services and its evaluation
5. **To propose the policy** for shared mobility

Scope and Limitation of the Study

1. The project Includes **all mode of Shared mobility** which are available in **Delhi**
2. Delhi has been taken as the case study to demonstrate an approach to evolve alternate development strategies & evaluate them.
3. Only Ola, Uber & Shuttle operators have been selected and study have been carried out these on user

LITERATURE

Defining Shared Mobility

Shared mobility is an innovative transportation strategy that enables users to gain short-term access to transportation modes on an "as-needed" basis

***Source** : Susan Shaheen, 2016, 'Shared Mobility: A Sustainability & Technologies'*

Classification of Shared Mobility

Car Sharing	• Round trip • One Way • Personal Vehicle Sharing
Scooter Sharing	• Example-Uber Bike, Ola Bike
Bicycle Sharing	• Public Bike Sharing • Closed Campus Bike Sharing • P2P Bike Sharing
Ride Splitting	• Car Pooling
Alternative Transit Services	• Shuttles • Micro Transit
On-Demand ride Services	• Ride Sourcing • Ride sharing

***Source** : Susan Shaheen, 2016, 'Shared Mobility: A Sustainability & Technologies'*

1. **Car Sharing** – The Principle is **Individuals gain the benefits** of private vehicle use **without** the costs and responsibilities of ownership. Example – **Zoom Car, Mylescar, VolerCars, Revv**

2. **Bicycle Sharing** - Its is the systems which allow users to access bicycles on an as-needed basis from a **network of stations**, which are typically concentrated in **urban areas**
   1. **Public Bike sharing** – *Examples* = **Available at BRT , Metro Station , BOUNCE**
   2. **Closed campus bike sharing** - *Examples* = **Available at College, amusement Park & national Parks**

3. **Ride Splitting** – It facilitates share rides between **drivers and passengers** with **similar origin-destination pairings.** Example – **Car pooling, bla-bla car**

4. **Alternative Transit Services** - Transportation options (which are **target special populations**) have **existed in parallel** to established public transit networks. Example - **vans, paratransit, and shuttles**
   1. **Shuttles** - connect **passengers to public transit stations or to employment centers.**
   2. **Micro transit** – Alternative transit service which can incorporate **flexible routing, flexible scheduling, or both**

5. **On-Demand Ride Services**
   1. **Ride sourcing-** Ride sourcing use **smartphone apps** to **connect community drivers with passengers**. Examples – **Ola micro, Ola mini and Ola prime, Uber Go, Uber Premier**
   2. **Ride Sharing -** Involves **sharing a ride sourcing ride with someone else** taking a similar route. Ola and Uber match riders with similar origins and destinations together, and they split the ride and the cost.

      Examples – **Ola Share, Uber Pool**

Indian Scenario

Classification is done as per Permit given to Operator :-

City Taxi	• Black & yellow Taxi
AITP (All India Permits for tourist Transport Operator)	
Radio Taxi	• Meru Cab • Mega Cab
Rent a Cab(for Car Rentals)	• Zoom car • Ola • Uber

Taxi Policy Guidelines,2016

- Based on the Excise duty criteria and the fact that over 87% of the cars are **less than 4 metres length**, the Taxis may be segregated into
  - **Economy (less than 4 m) and**
  - **Deluxe (more than 4 m)**
- **Dynamic pricing** to be allowed to effectively match demand and supply.
- Maximum tariff may be permitted up to three times the minimum tariff.

Source: Ministry of Road Transport and Highways – Taxi Policy Guidelines,2016

Demand – Supply = GAP <--> Shared Mobility

11th Urban Mobility India Conference & Expo 2018

INSTITUTE OF URBAN TRANSPORT (INDIA)

DATA BASE

Primary Survey
- User Survey
- Non-User Survey
- Operator Survey (Driver's Survey)

Information needed to collected

1. Socioeconomic parameters
2. User Attributes
3. Non user Attributes/ Vehicular Attributes
4. Operators Attributes

Choice of Sample Size

- Since the aim of the study is to examine which group predominately uses shared mobility for what purpose
- 6 Purposes categories with Shared mobility users and non-users give **12 stratified classes**
- Assuming **35 samples** in each of the strata gives a total sample size of about **420 samples**

Methodology Adopted For Conducting Survey

- Interview Survey & Google online form Survey
- Since different purpose users needed to captured so the interviewing of User and non-user is performed at **different Land uses**

Socioeconomic Attributes
Gender
Age
Education
Occupation
Income
Vehicle Ownership

User Attributes
Types
Purpose
Number of trips
Trip Length
Travel Time
Travel Cost
Availability
Access
Reliable
Safety
Payment(wallet/ Card)
Driver behaviour
Drivers Knowledge

Vehicular Attributes
Vehicle Numbers
Fuel Type
Age of Vehicle
Vehicular Occupancy
Operational Hours
Parking hours
Parking Charges

Operator Attributes
Cab Detail
Cab Category
Fuel Type
Ownership
Age of Vehicle
Operational Detail
Number of passengers
Distance Travelled
Fuel & Maintenance
Average waiting time
Trip Targets (per day)
Monthly Expenses
Cab Financing (EMI etc.)
Drivers Personal Detail
Age
Cab ownership
In Cab Business (Years)

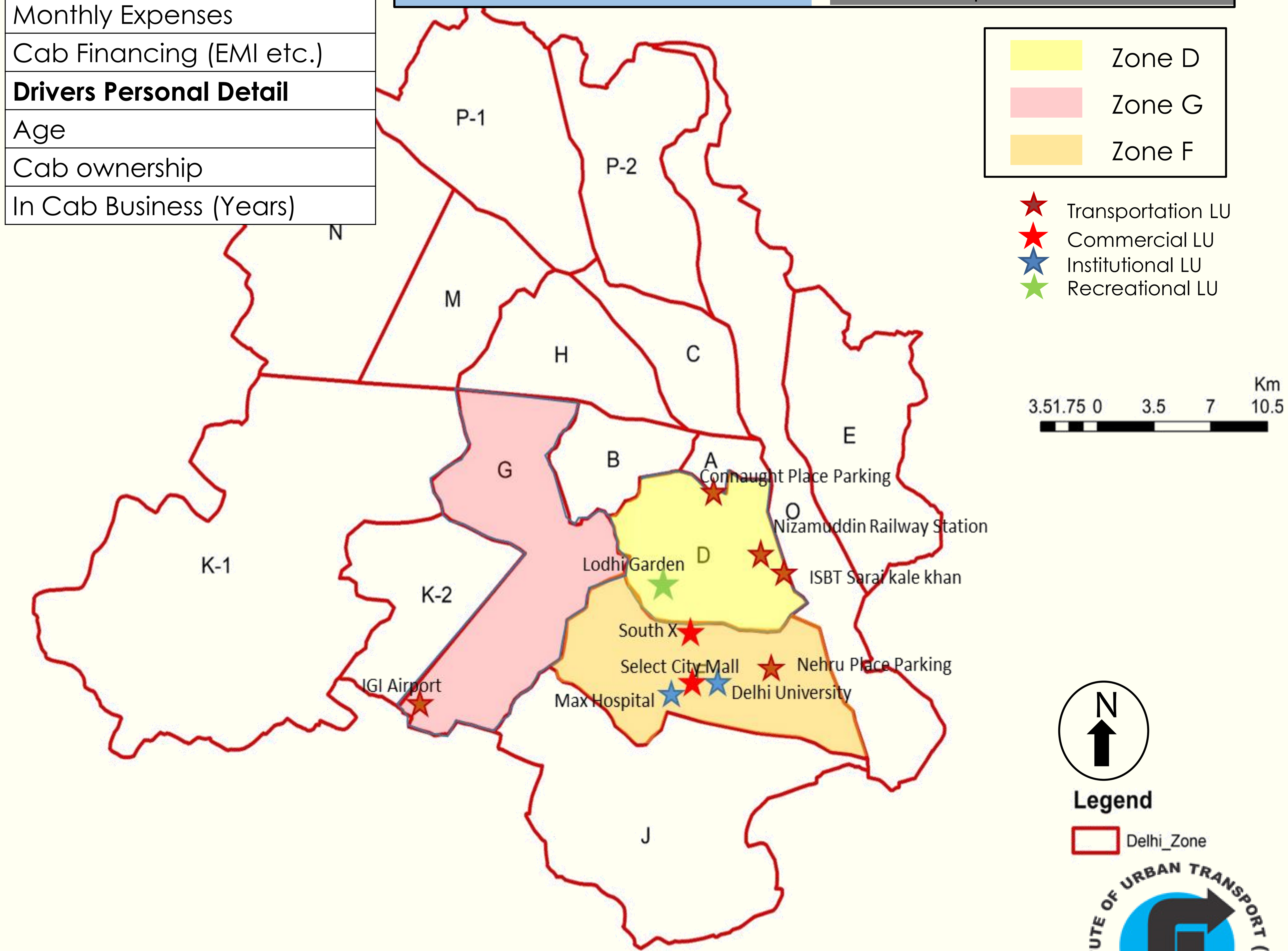
Land Uses :-

Commercial Area
- Select City Mall, Saket
- South X Market

Institutional Area
- Max Hospital, Saket
- Delhi University (Vocational College, ARSD)
- IT Sectors

Recreational Area
- Lodhi Garden

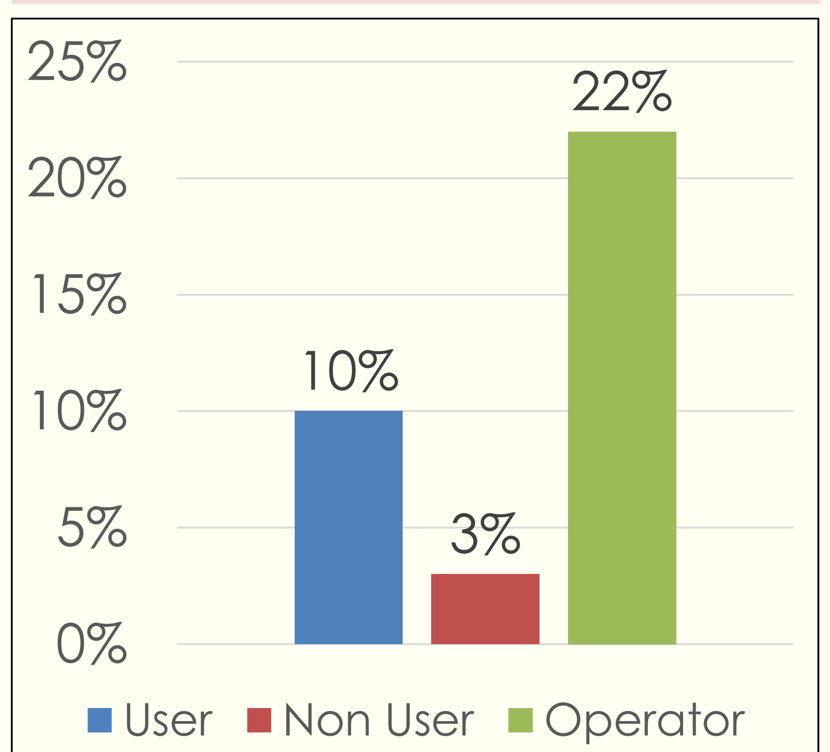
Transportation
- Nizamuddin Railway Station
- Connaught Place Parking
- Nehru Place Parking
- ISBT Sarai kale khan
- IGI Airport



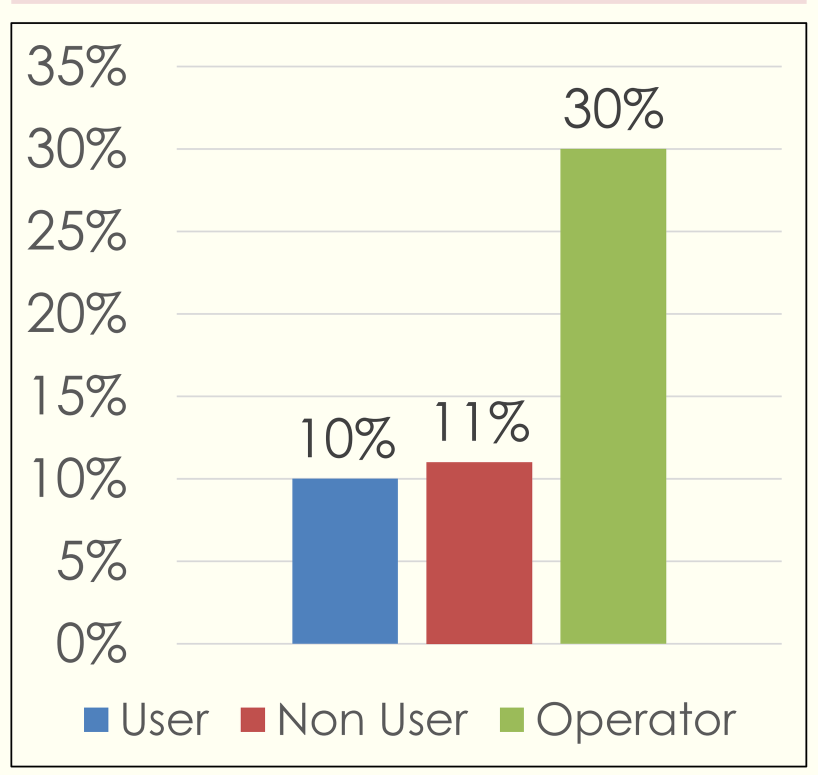
DATA BASE

	User	Non User	Total	Operator
Commercial Land Use				
Select City Mall	27	20	90	21
South X	20	23		1
% Share	**14%**	**17%**	**19%**	
Institutional Land Use				
Max hospital, Saket	17	26	215	7
Delhi University (Bhagat Singh)	9	39		
	95	32		
	37%	**38%**	**39%**	
Recreational Land Use				
Lodhi Garden	6	27	33	2
	2%	**10%**	**6%**	
Transportation land Use				
Nizamuddin Railway Station	30	14	242	20
Connaught Place Parking	32	26		2
Nehru Place Parking	21	20		4
ISBT Sarai kale khan	18	17		
IGI Airport	53	14		16
	47%	**35%**	**36%**	
Total	**325**	**253**	**543**	**73**

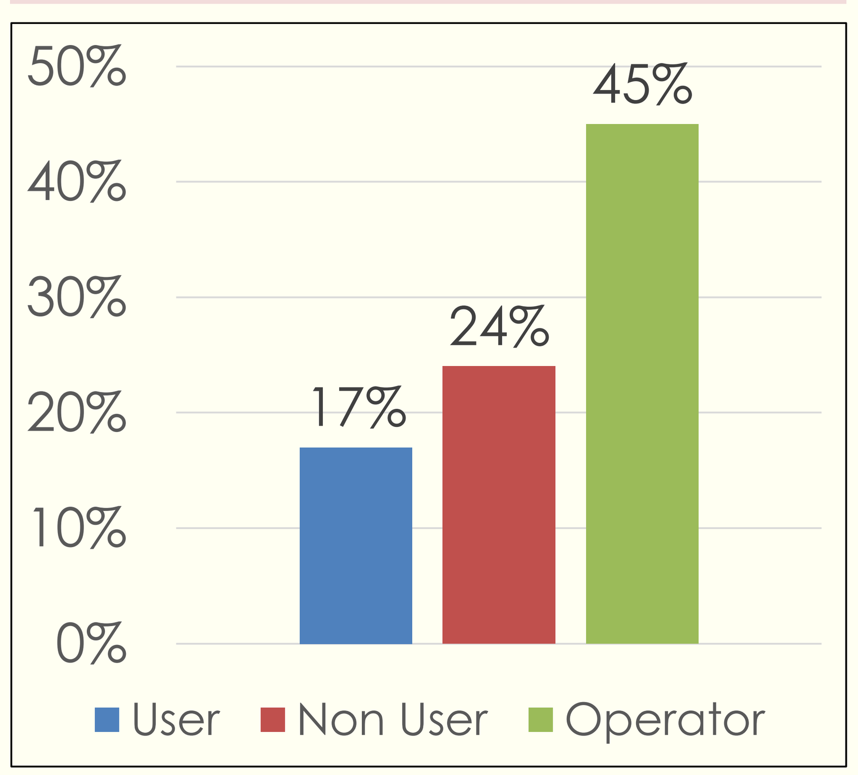
Zone G



Zone D

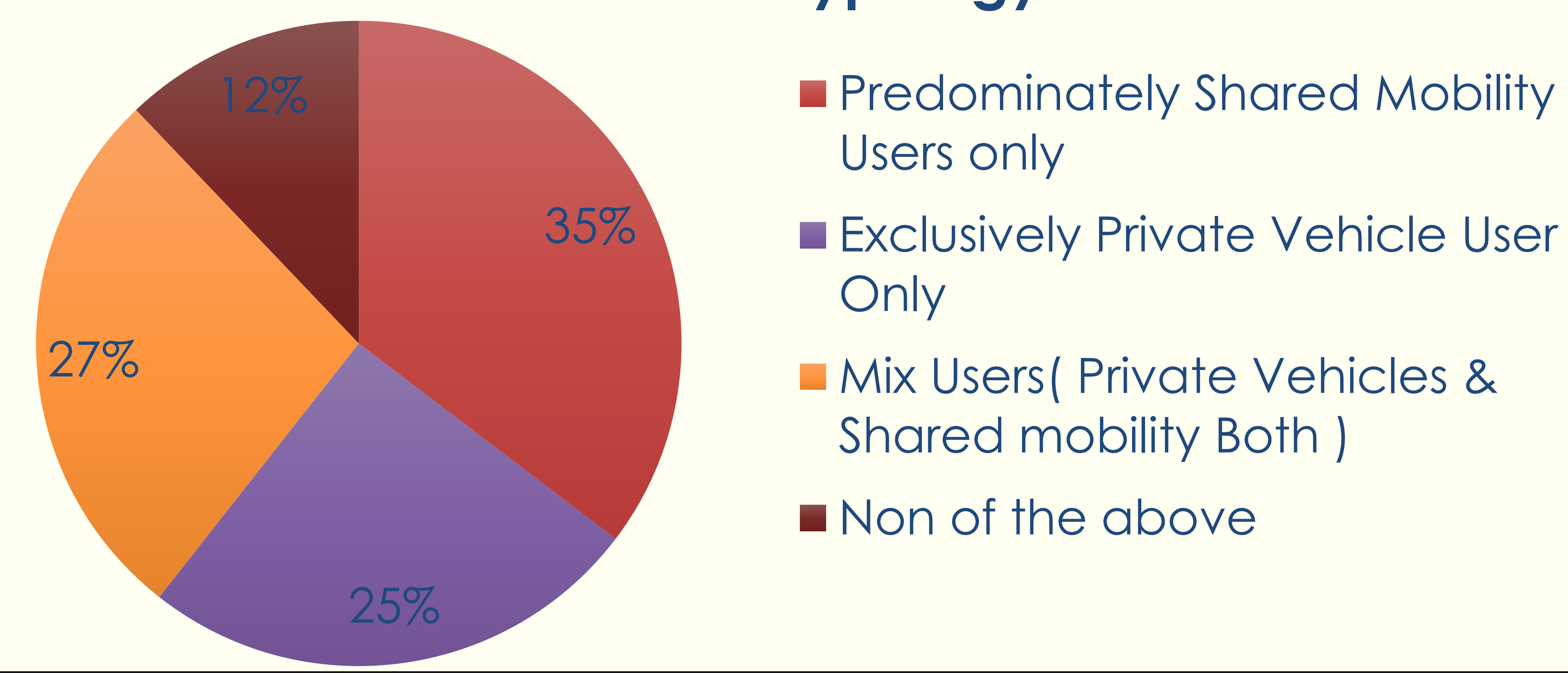


Zone F



Number of Samples Collected	Nos.	%Share
Predominately Shared Mobility only	192	**35%**
Exclusively Private Vehicle Only	137	**25%**
Mix(Private Vehicles & Shared mobility Both	147	**27%**
Non of the above	67	**12%**
Total	543	**100%**

User & Non User Typology



User	Predominately Shared Mobility Users only
	Mix(Both Private Vehicles & Shared mobility)
Non User	Exclusively Private Vehicle User Only
	Mix(Both Private Vehicles & Shared mobility)

Type	Samples	Nos.	%Share
User	192+147	339	49 %
Non User	137+147	284	51 %

Observation :-

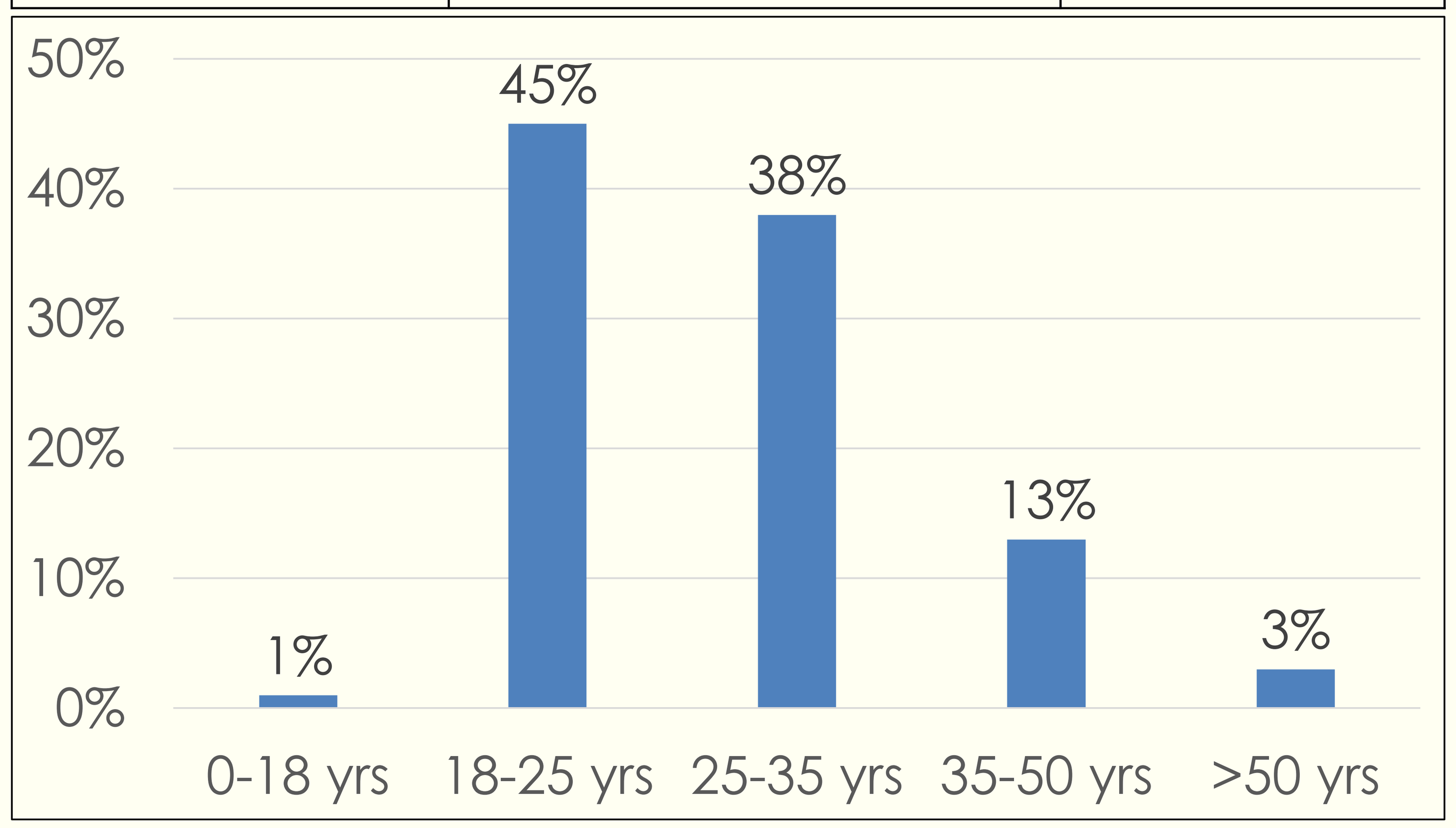
- **35%** of the samples are using **Shared Mobility on daily basis**
- **Users (Shared Mobility) analysis** is done from **339** samples collected
- **Non User (Private Vehicles) analysis** is done from **284** samples
- **12%** of the above Samples collected have been **excluded** in the analysis

Source : Primary Survey, feb 2018

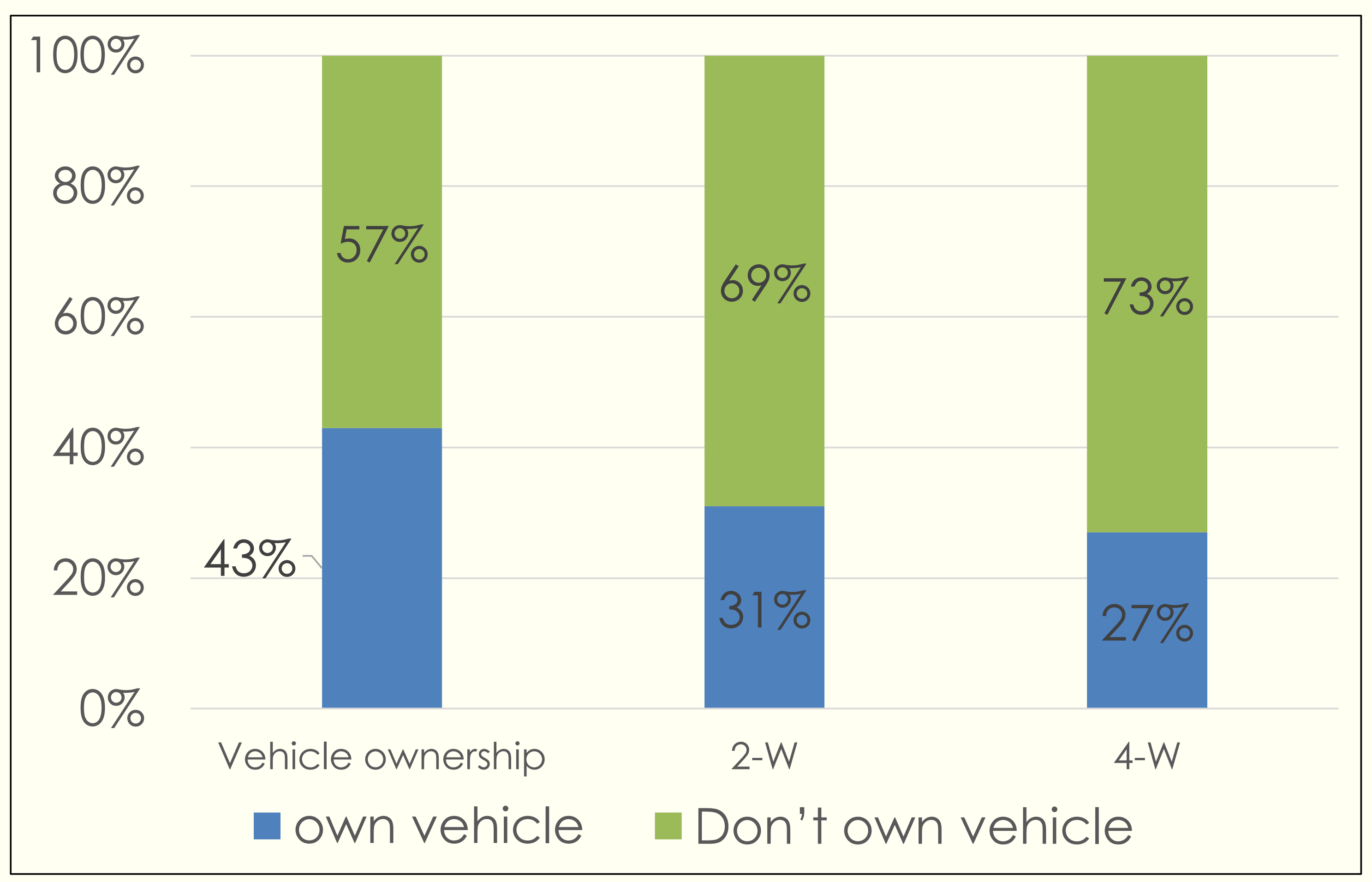
SOCIO-ECONOMIC CHARACTERISTICS OF SHARED MOBILITY USERS

Gender	Numbers	%Share
Male	277	**67%**
Female	112	33%
Total	339	100%

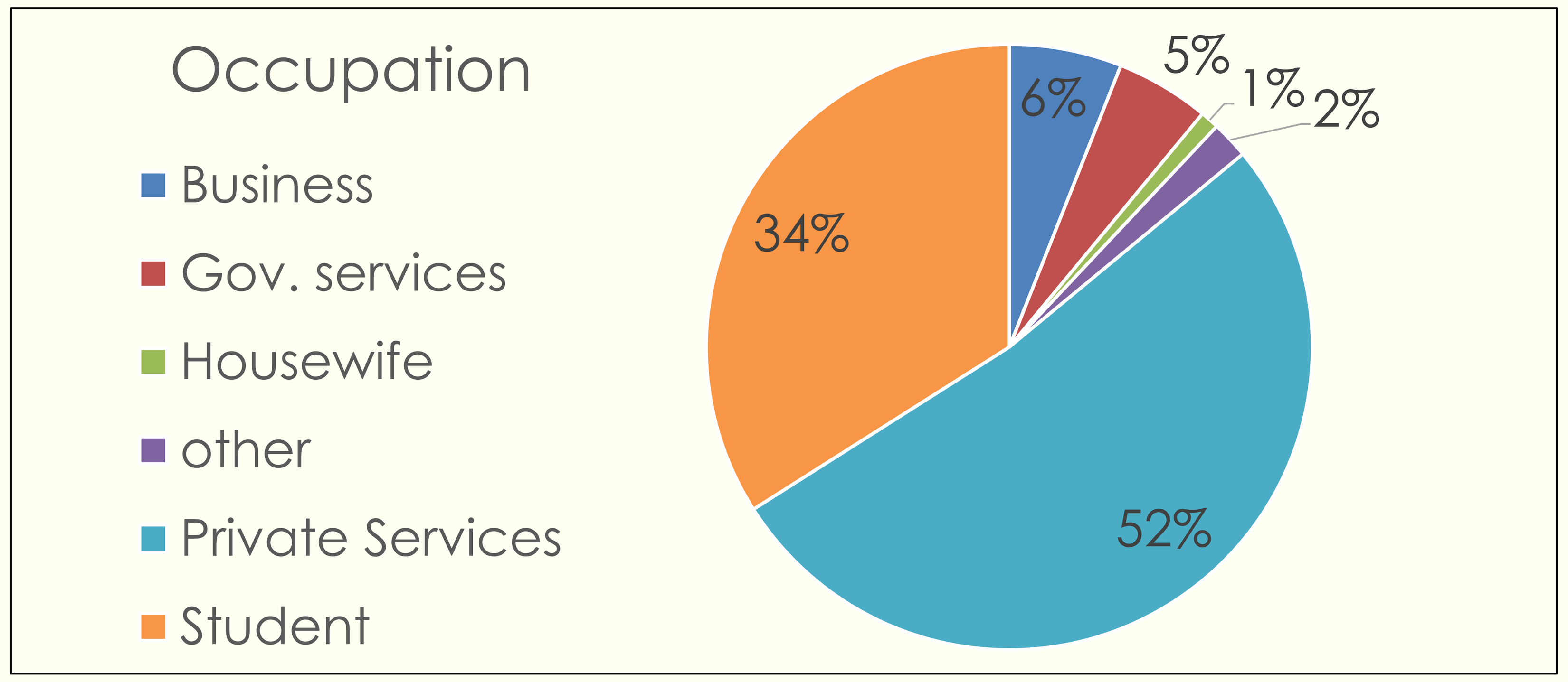
Age	Numbers	%Share
<18 yrs	34	1%
18-25 yrs	166	**45%**
25-35 yrs	142	**38%**
35-50 yrs	27	13%
>50 yrs	34	3%
Total	339	100%



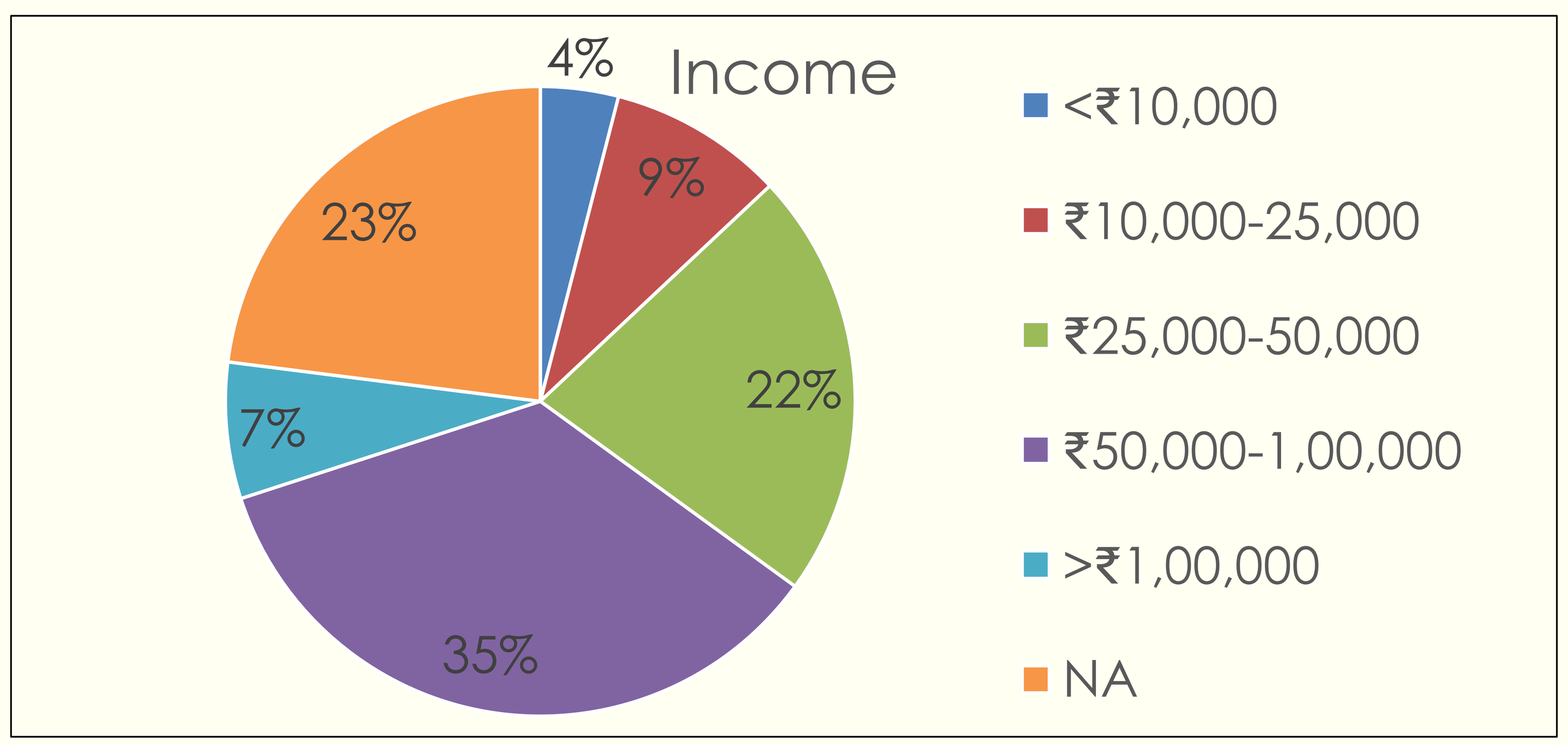
Vehicle Ownership



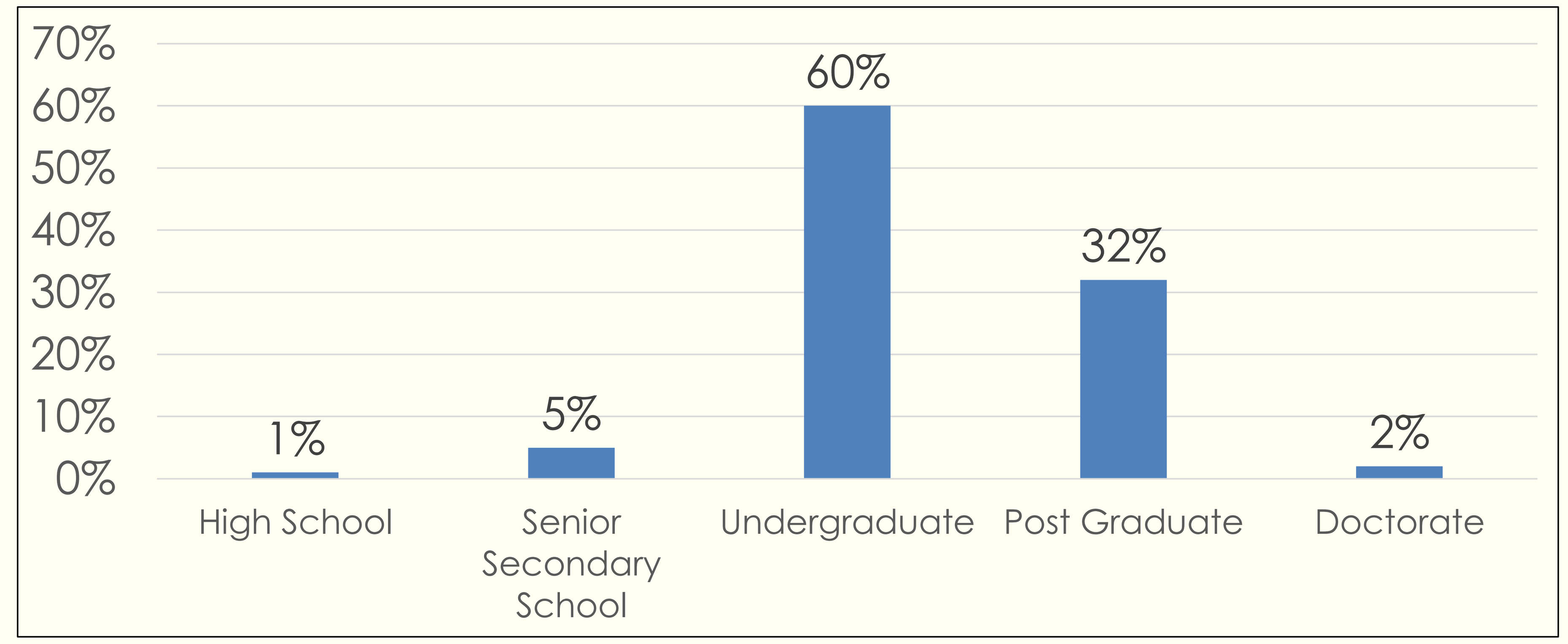
Occupation	Numbers	%Share
Business	20	6%
Public Service	17	5%
Housewife	3	1%
Other	7	2%
Private service	176	**52%**
Student	115	**34%**
Total	339	100%



Income	Numbers	%Share
<₹10,000	30	4%
₹10,000-25,000	84	9%
₹25,000-50,000	153	**22%**
₹50,000-1,00,000	81	**35%**
>₹1,00,000	72	7%
NA	123	**23%**
Total	543	100%



Education	Numbers	%Share
High School	34	1%
Senior Secondary School	67	5%
Undergraduate	203	**60%**
Post Graduate	122	**32%**
Doctorate	67	2%
Total	339	100%



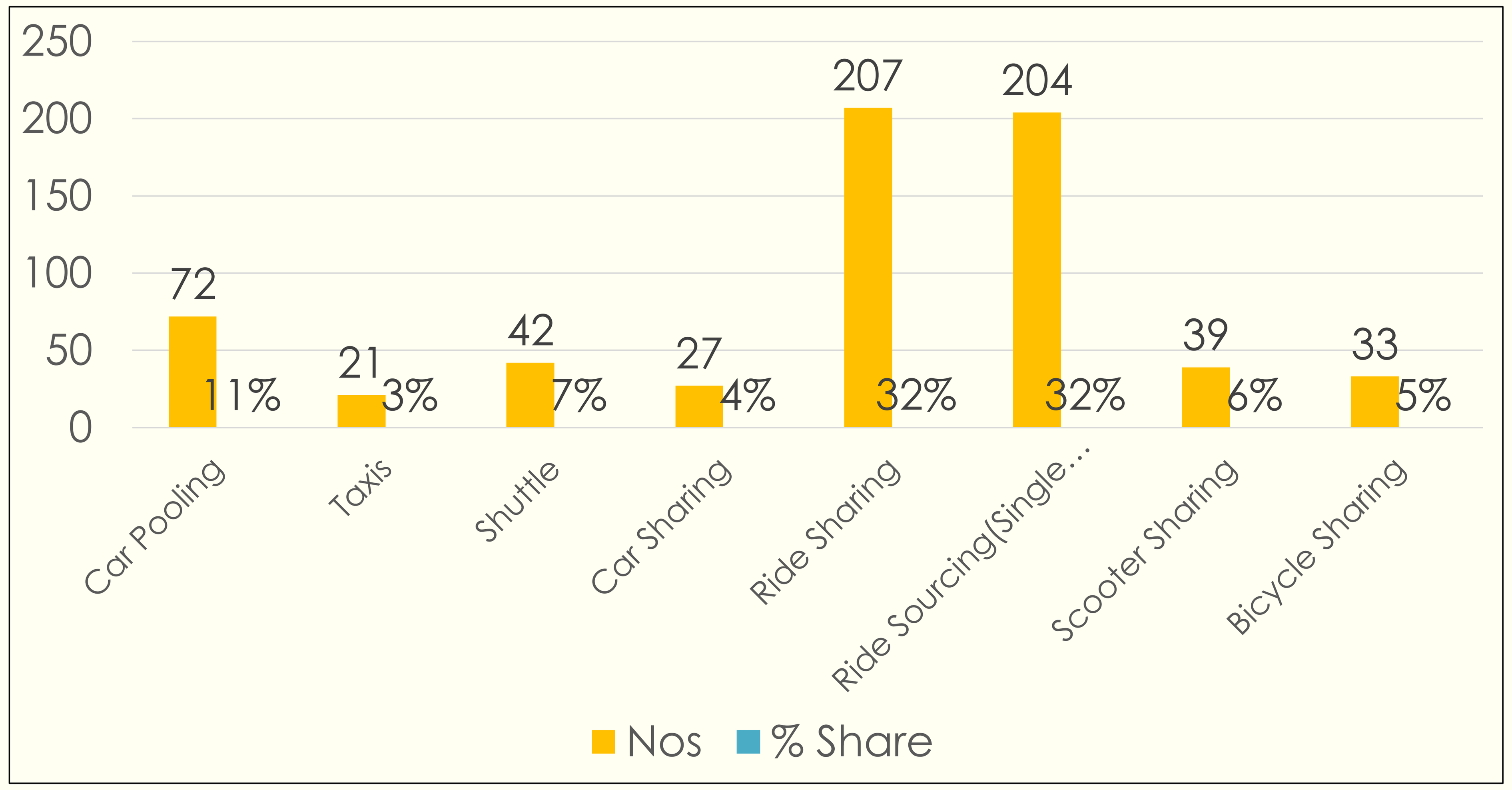
Observation:-

- **67%** of Shared Mobility users are **male**
- **83%** of the Shared mobility users lies in the age range of **18-35 years**
- **92%** of the sample users are either Undergraduate**(60%)** or post Graduate**(32%)**
- **43%** of samples **own a vehicle** and are still **using Shared mobility services.**
- Majority of user are from Private Service (52%) followed by **student (34%)**
- Shared mobility users lies in the **income** range of **₹50,000 to ₹1,00,000 (35%)** followed by **₹50,000 to ₹1,00,000 (22%)**

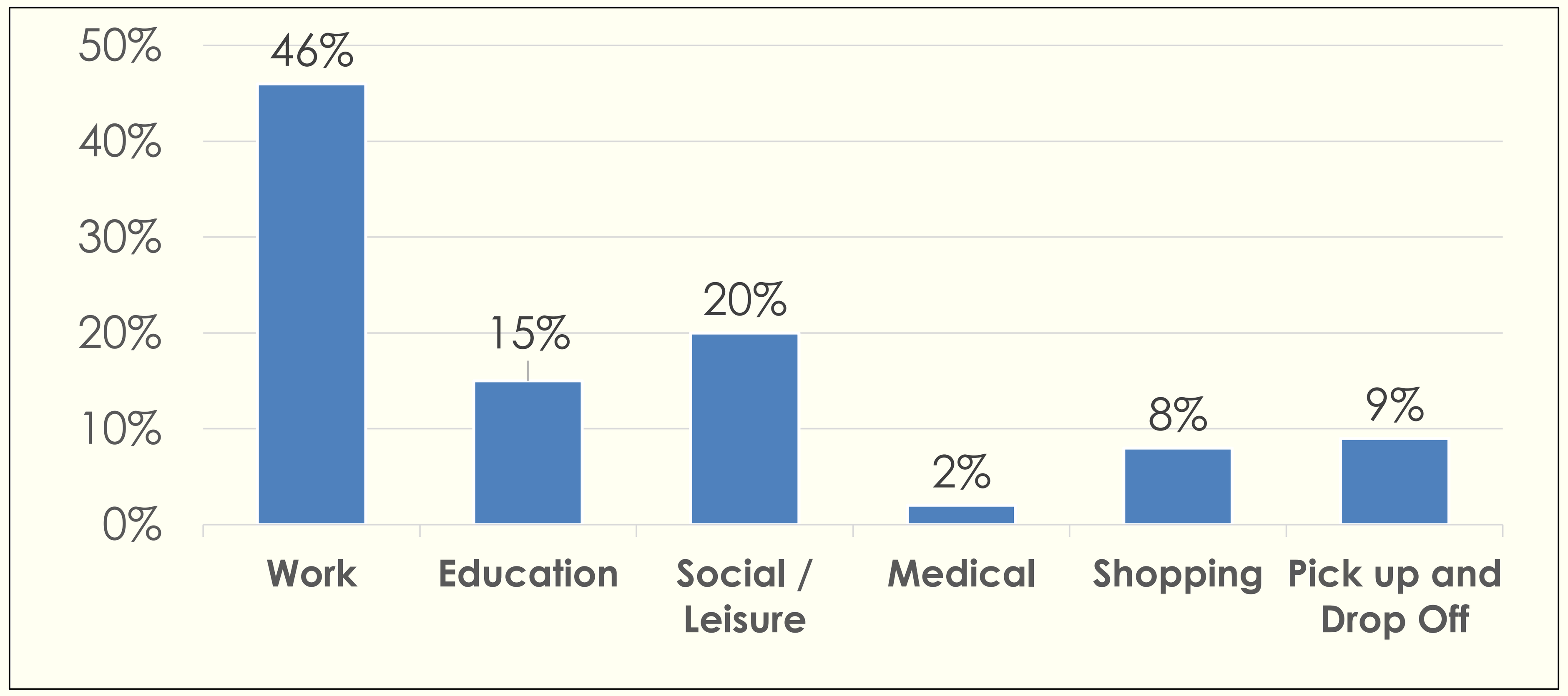
Source : Primary Survey, feb 2018

TRAVEL CHARACTERISTICS OF SHARED MOBILITY USERS

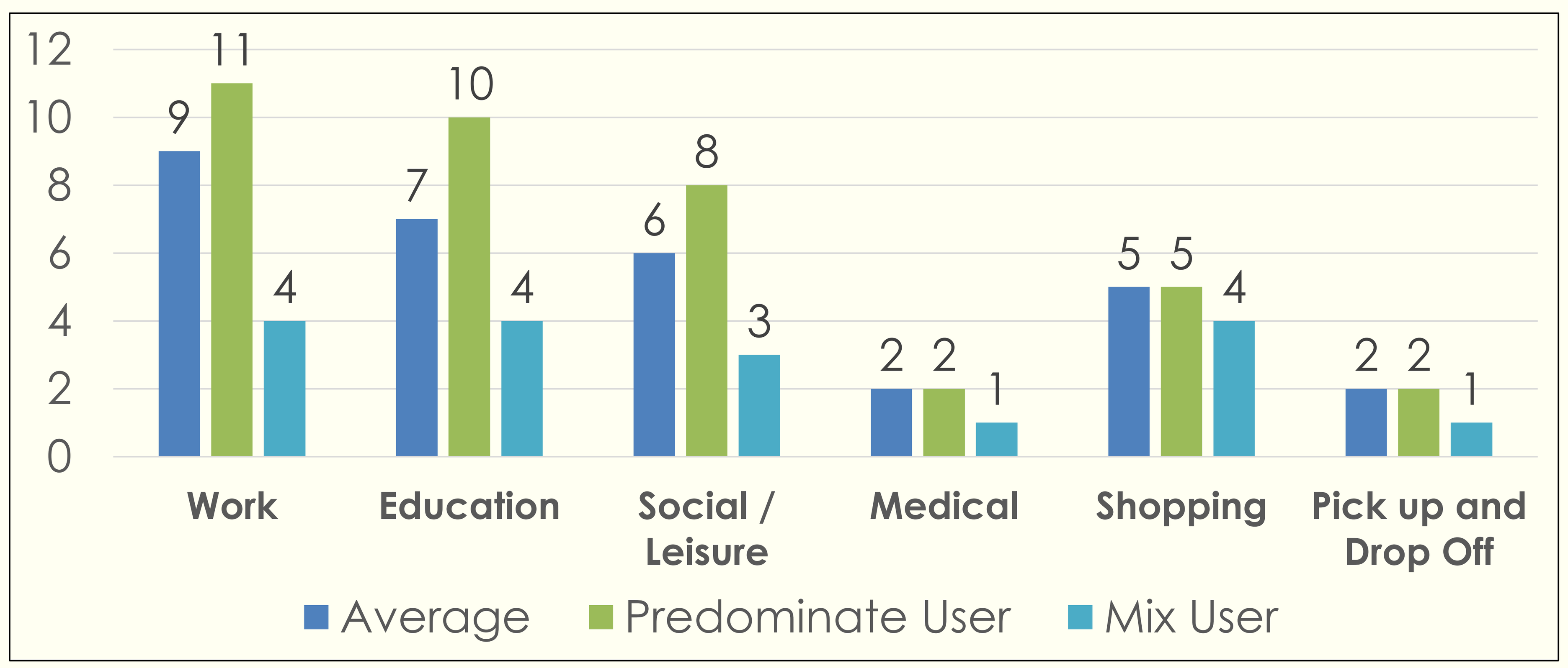
Shared Mobility User Types



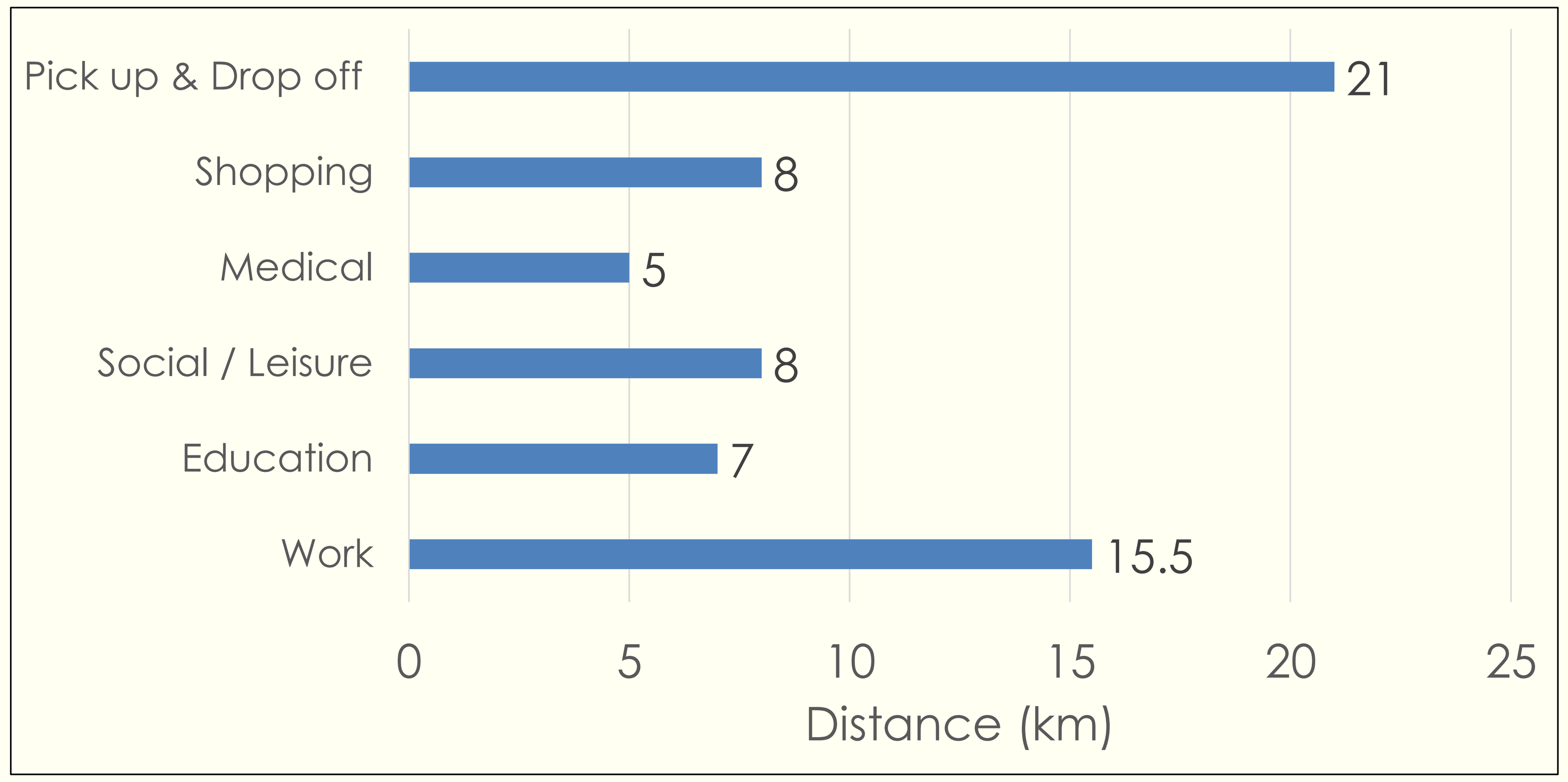
Purpose



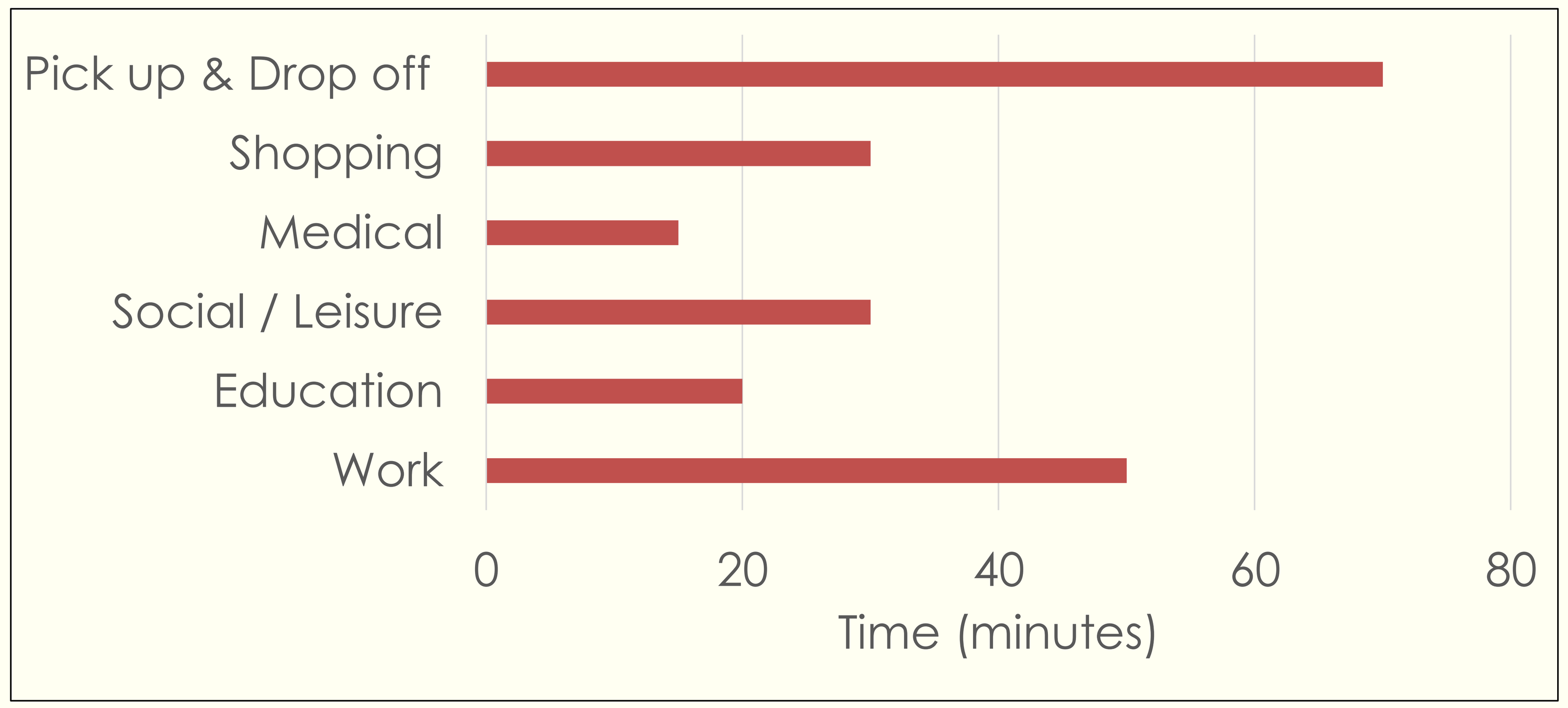
Number of trips made (per week)



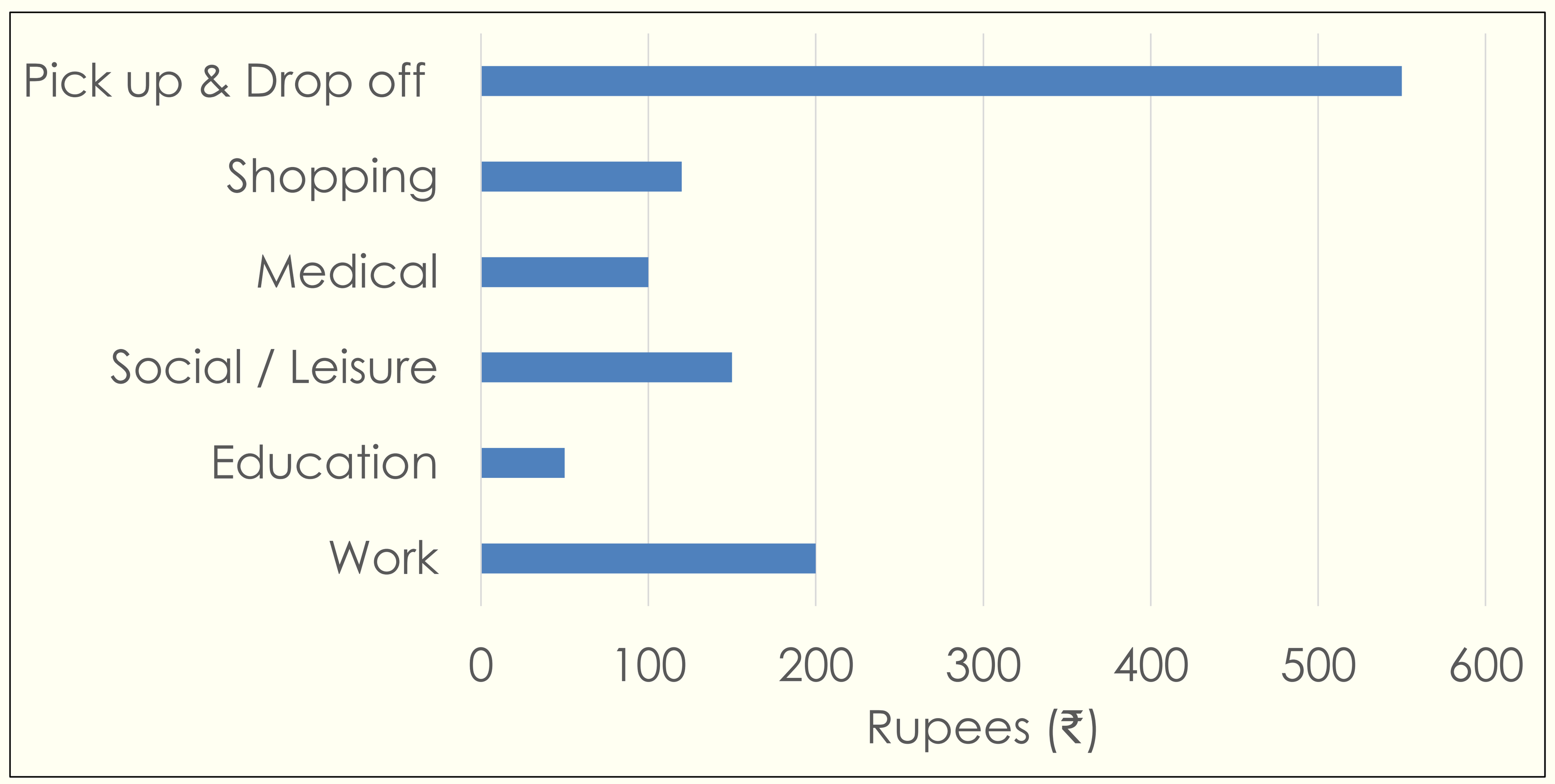
ATL(Average Trip Length)



Average Travel time



Travel Cost



Observation:-

Ride Sharing = Uber Pool or Ola Share
Ride Sourcing = Single Ride (Micro or GO)

- **64%** of made by trips done by **Ride Sharing(32%) and Ride Sourcing(32%)**
- **46%** of the trips are being performed by for **Work purpose** followed by **social/Leisure (20%)** and **Education (15%).**
- **9%** of the trips are made for **pick up and drop off** from Airport or Railway station
- **ATL(Average Trip Length)** for **Pick and drop off** purpose is maximum of **21km** followed **by Work 15.5km**
- **15% trips** is made for **Education** purpose but **predominate user** of **Work** and **Education** makes **same** number of trips in a week
- **ATL** is **maximum** for **Pick up and drop off** is 21km but **frequency is 2** which in **minimum** compare to other purpose
- **Travel Cost** for pick and drop off is **enormously high** for pick and drop off because change in rate slab

₹9 per km till 8 km
₹11 per km till 15 km
₹18 per km after 15 km

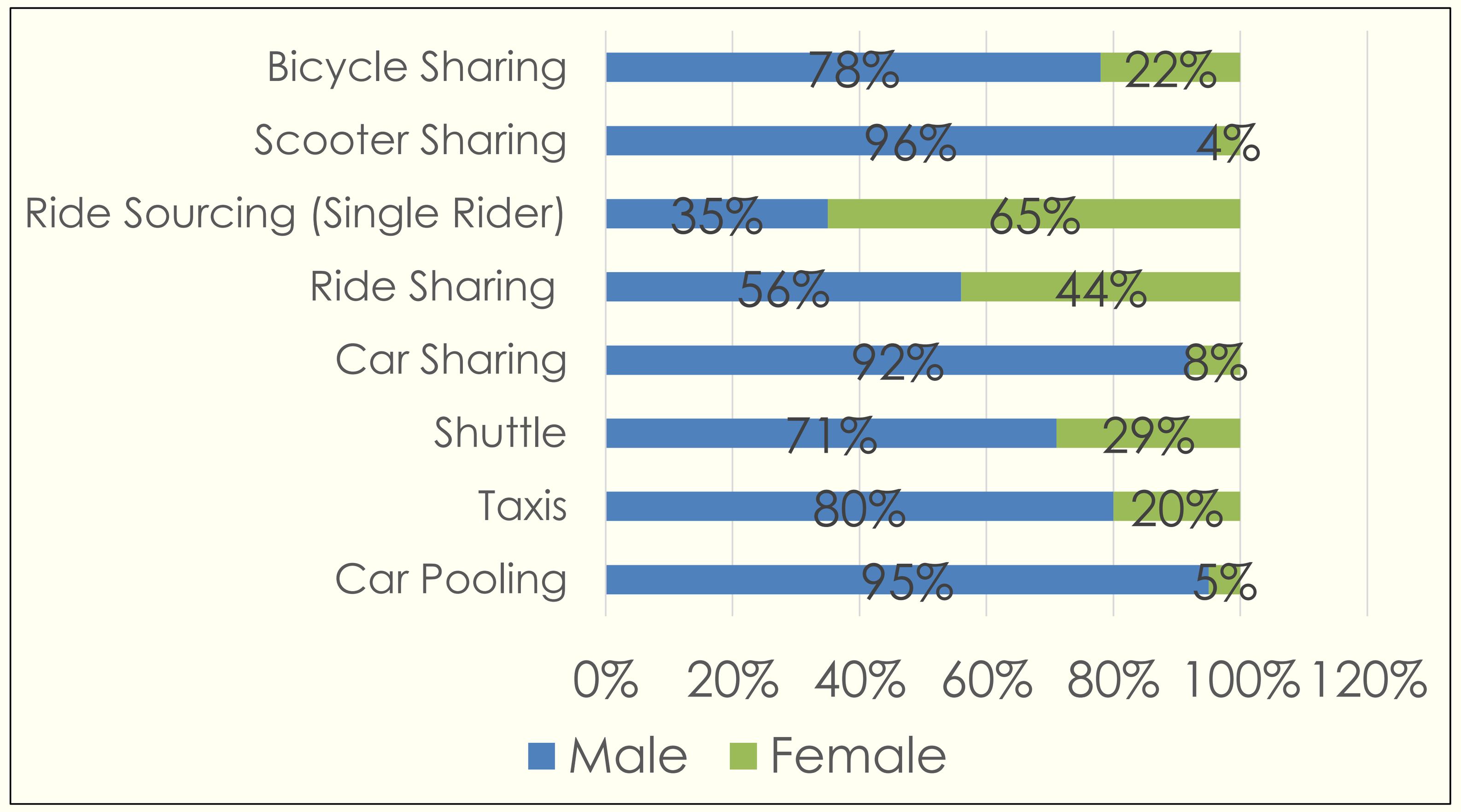
Source :OLA, Primary Survey, feb 2018

11th Urban Mobility India Conference & Expo 2018

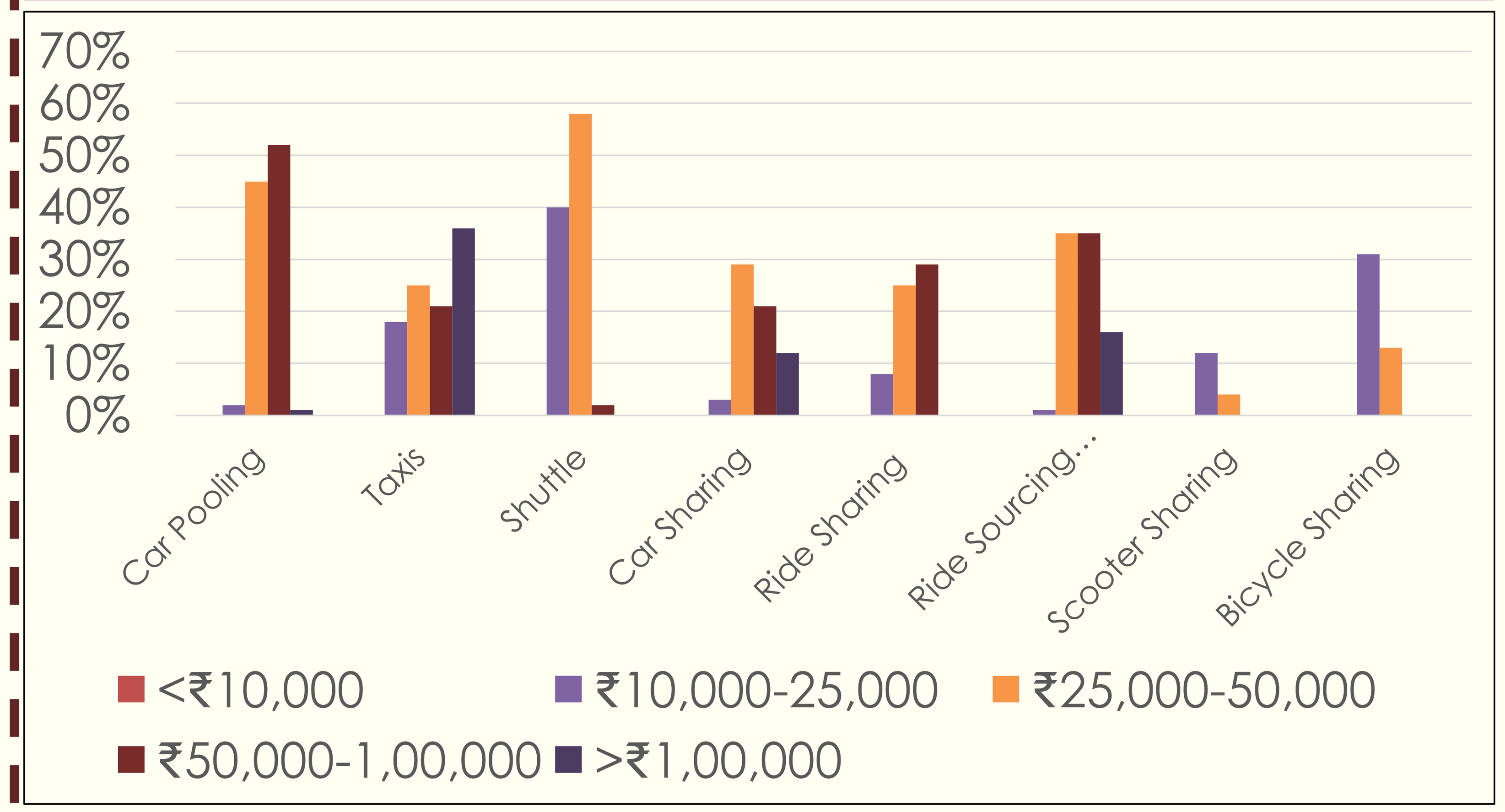
INSTITUTE OF URBAN TRANSPORT (INDIA)

SOCIO ECONOMIC WITH TRAVEL CHARACTERISTICS OF SHARED MOBILITY USERS

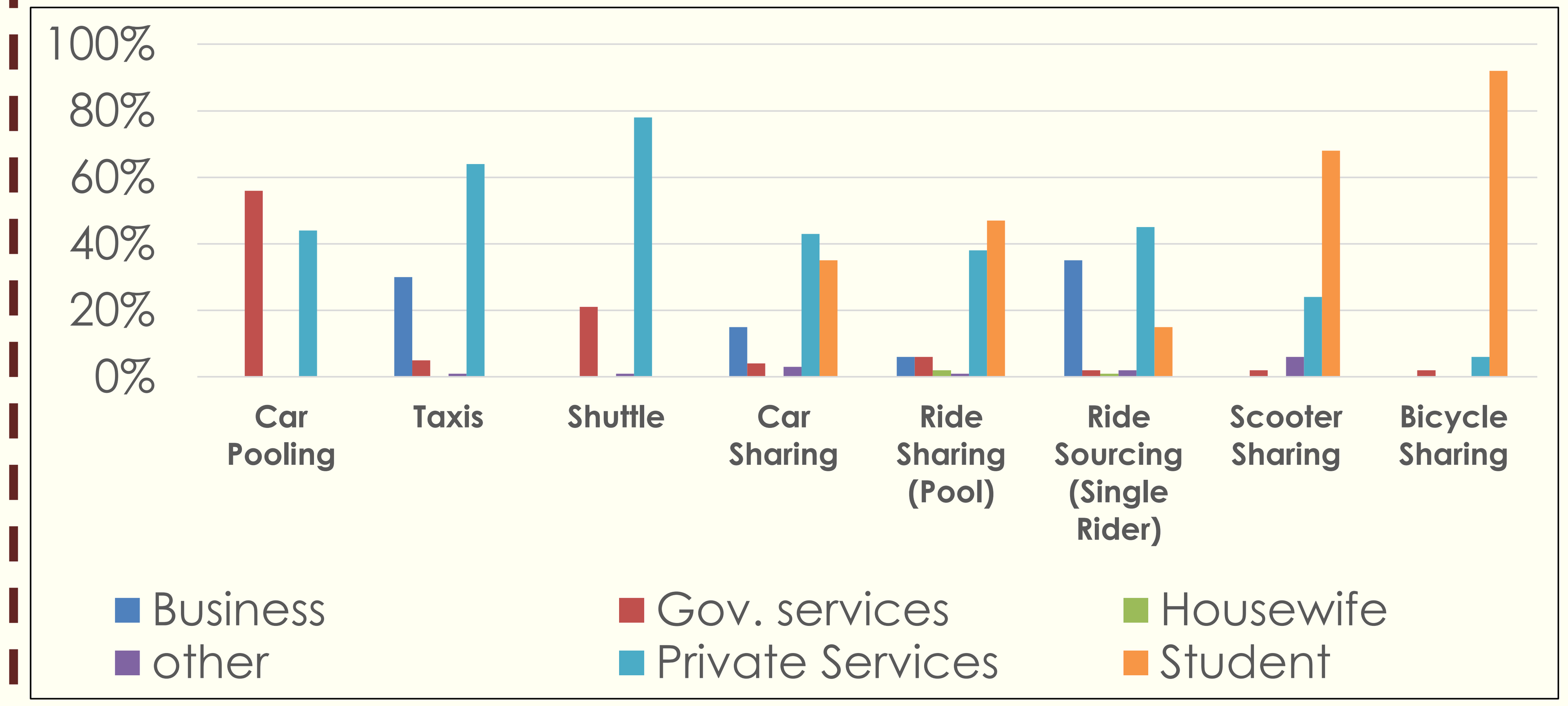
Gender and Mode Types



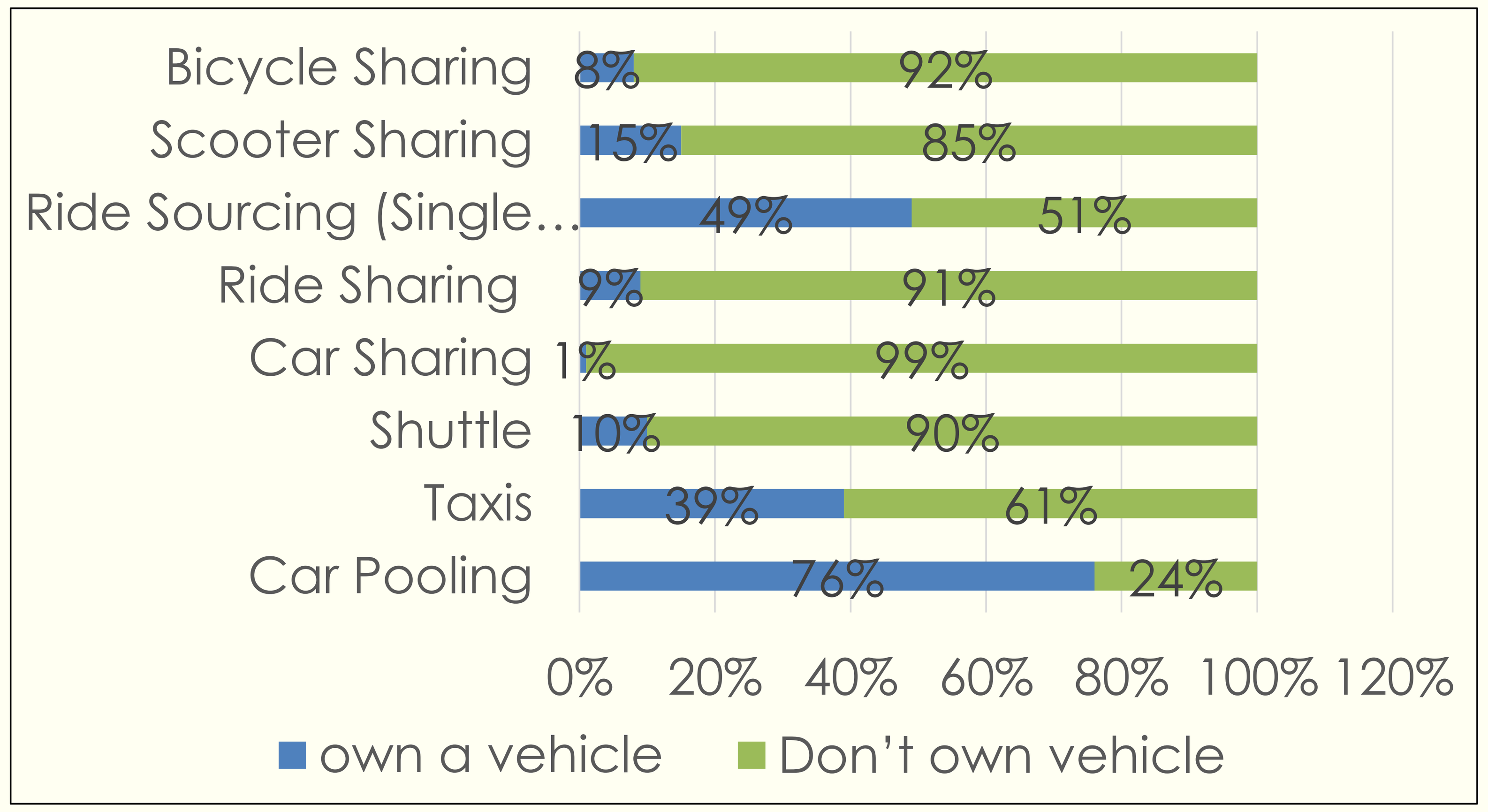
Income



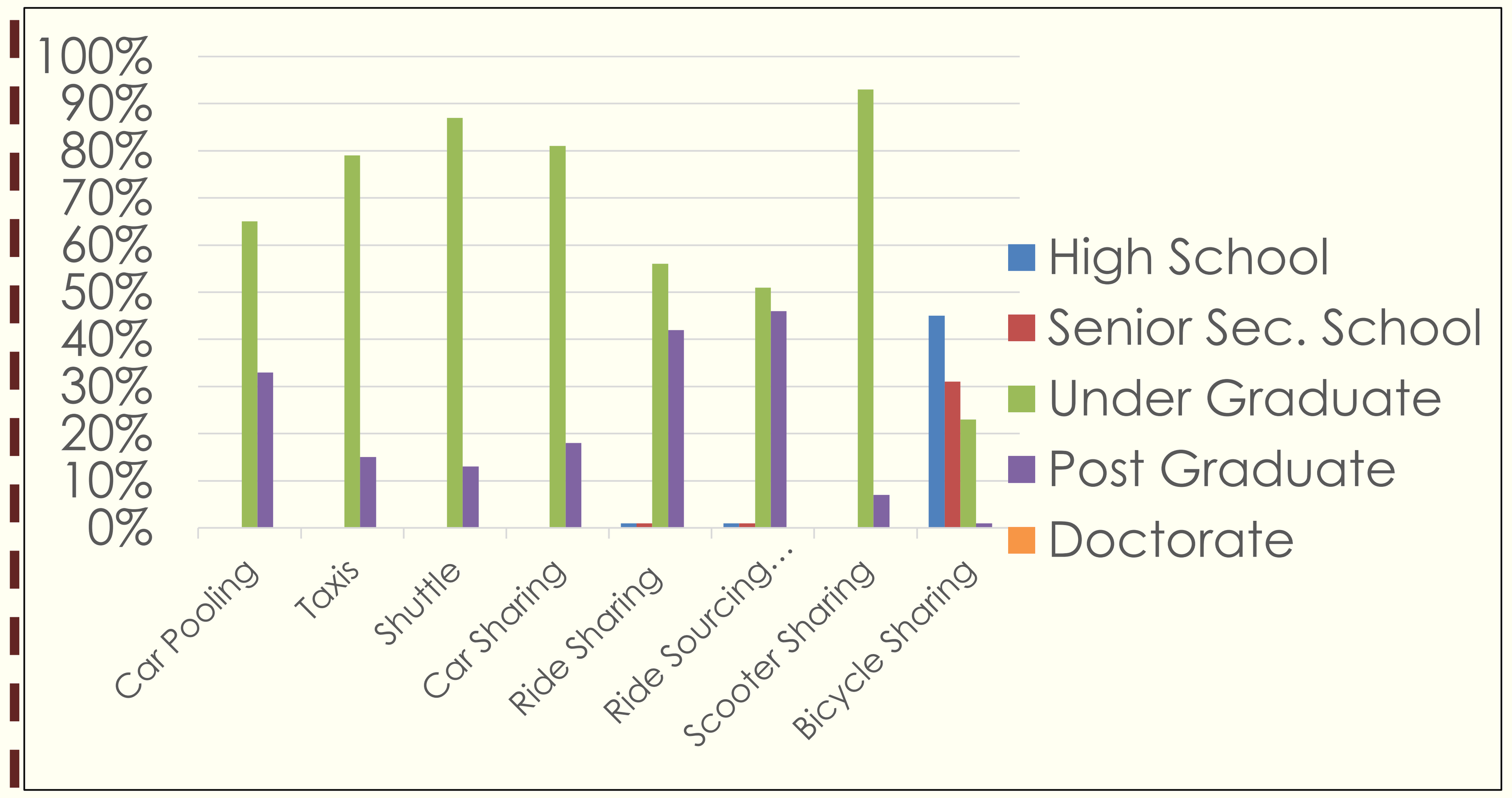
Occupation with Modes Types



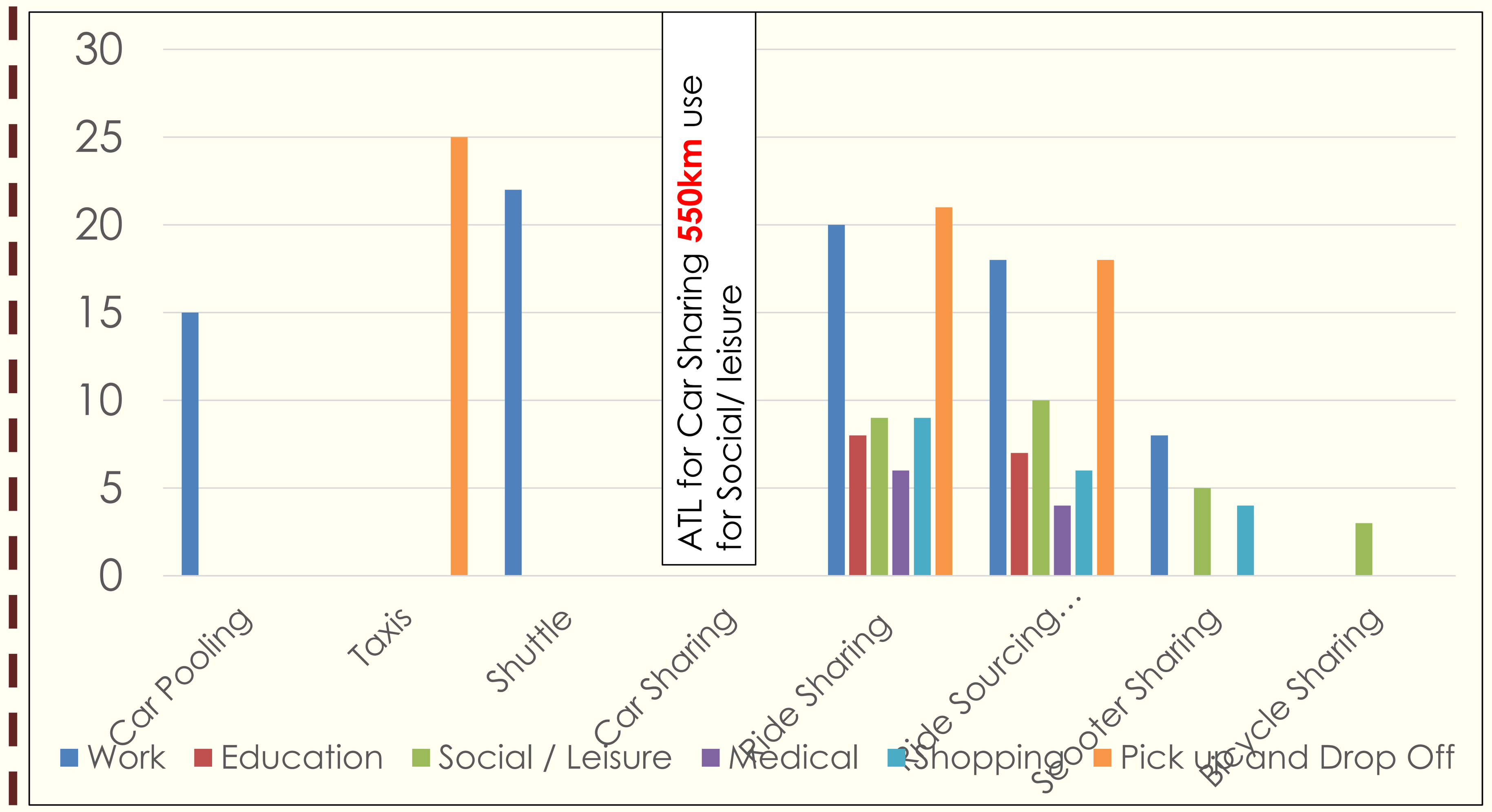
Vehicle Ownership with Mode Types



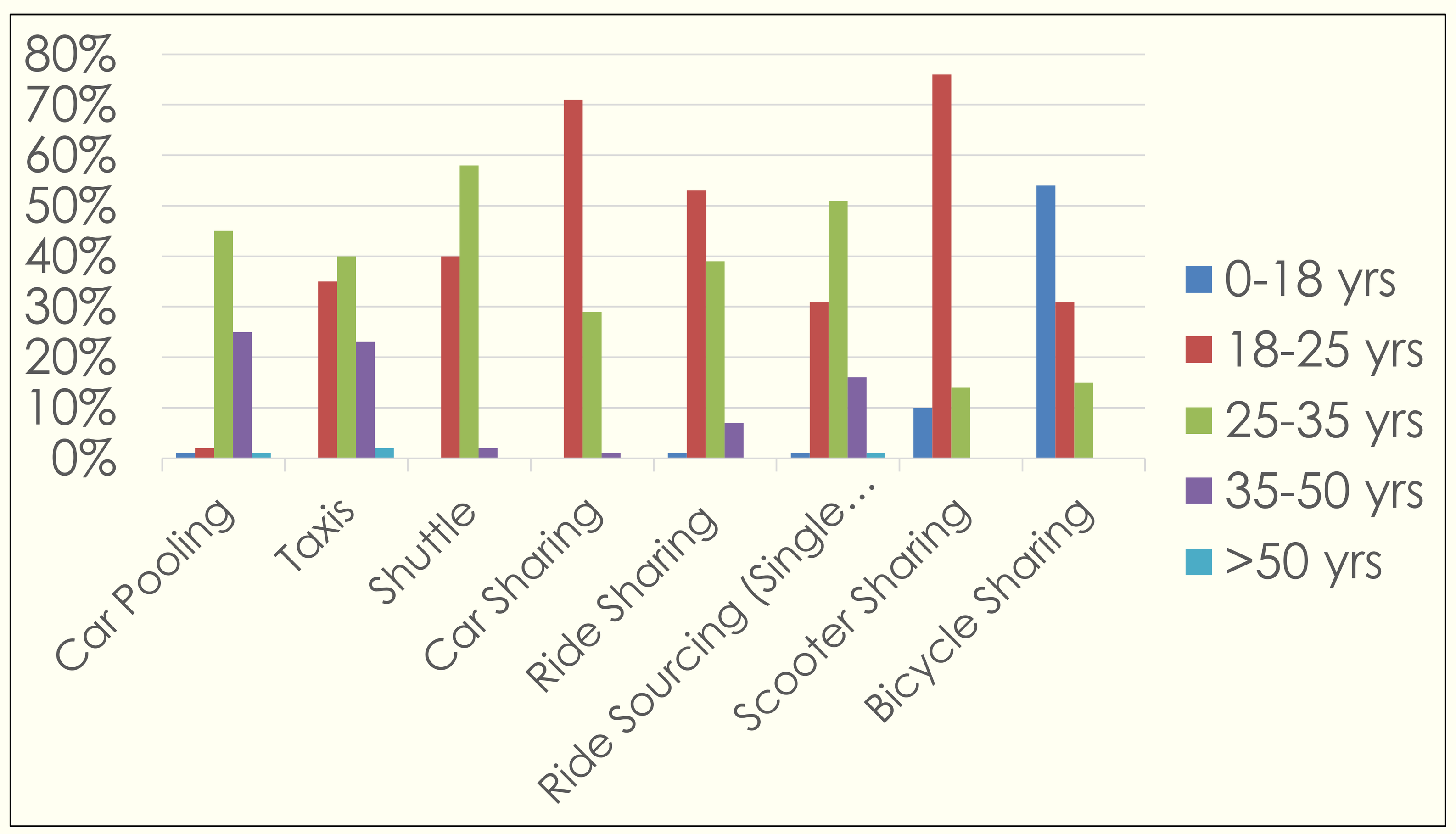
Education and Mode Types



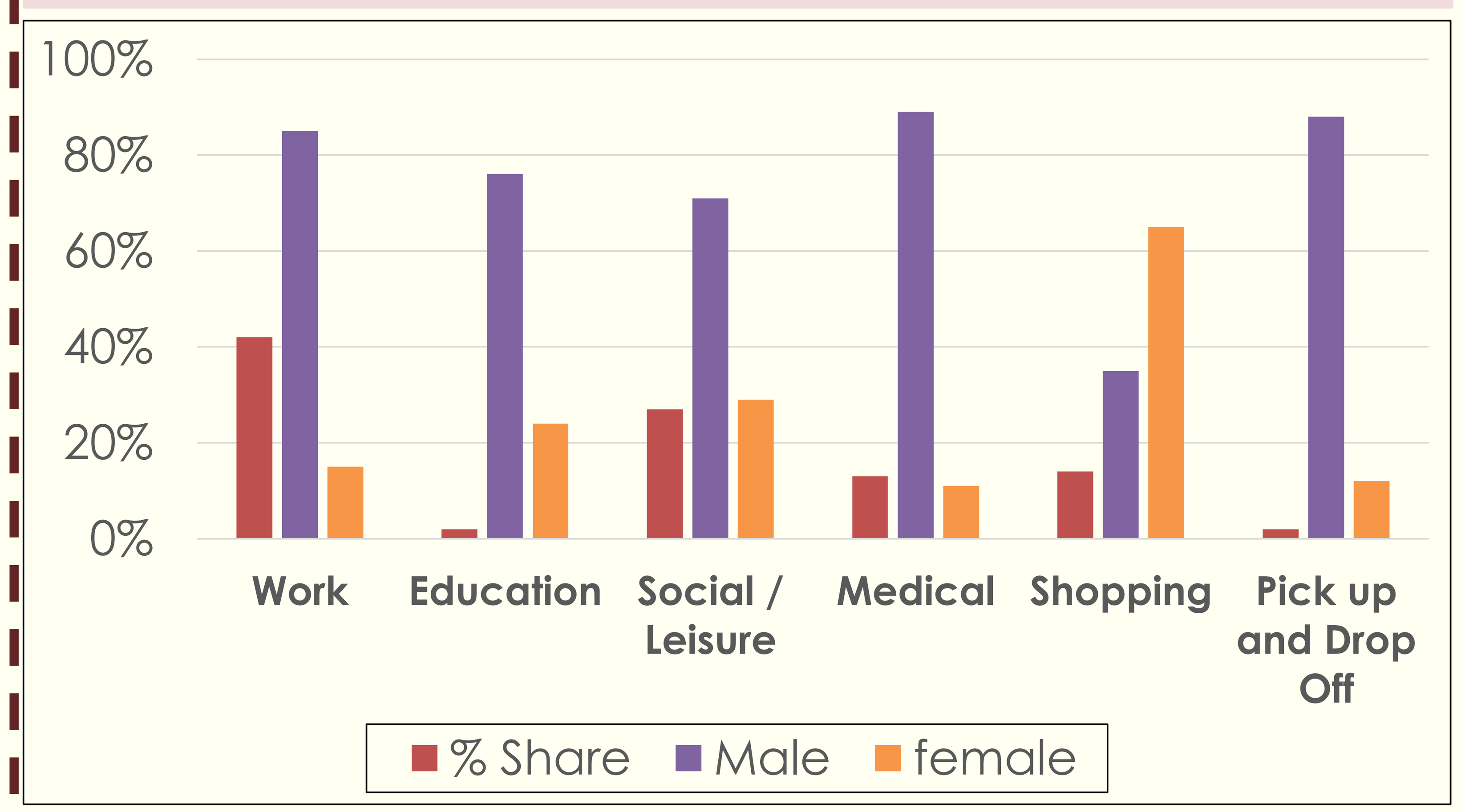
Purpose for different mode And ATL



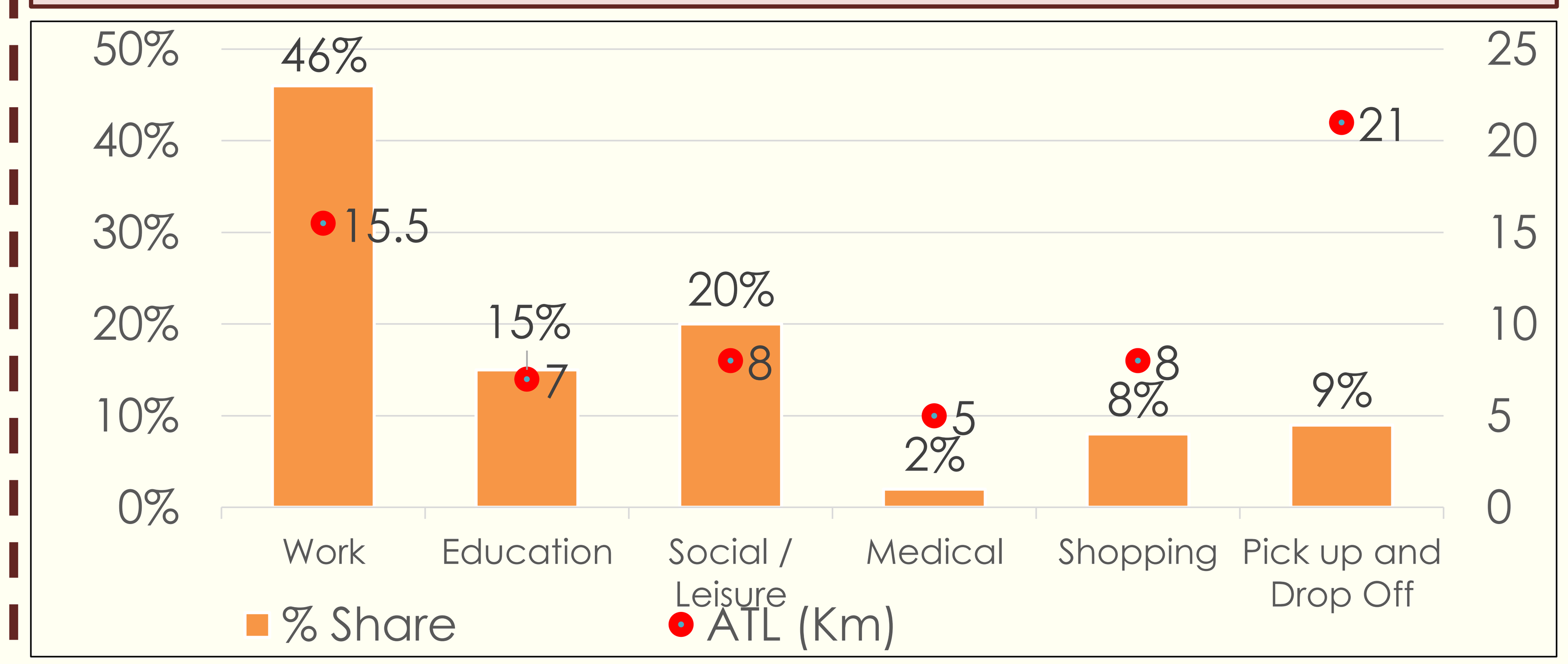
Age and Mode Types



Purpose And Gender



Purposes And ATL



Source : Primary Survey, feb 2018

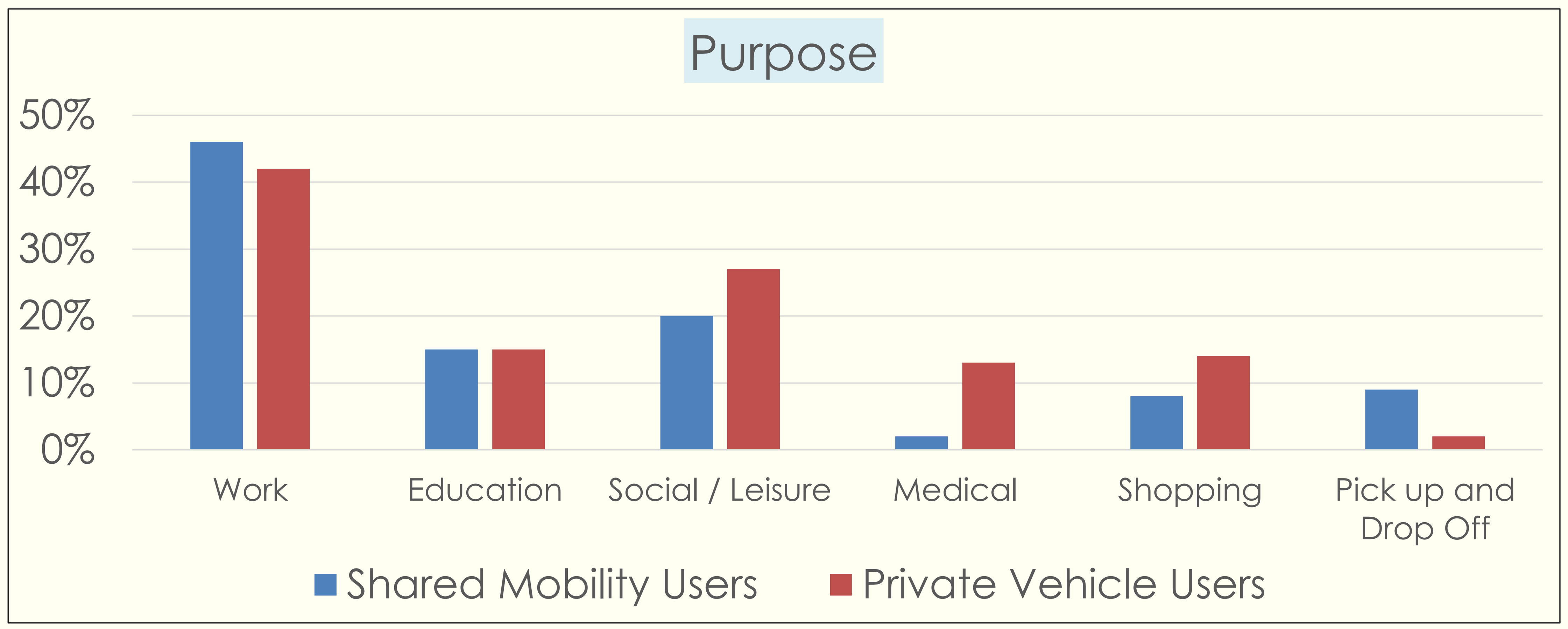
11th Urban Mobility India Conference & Expo 2018

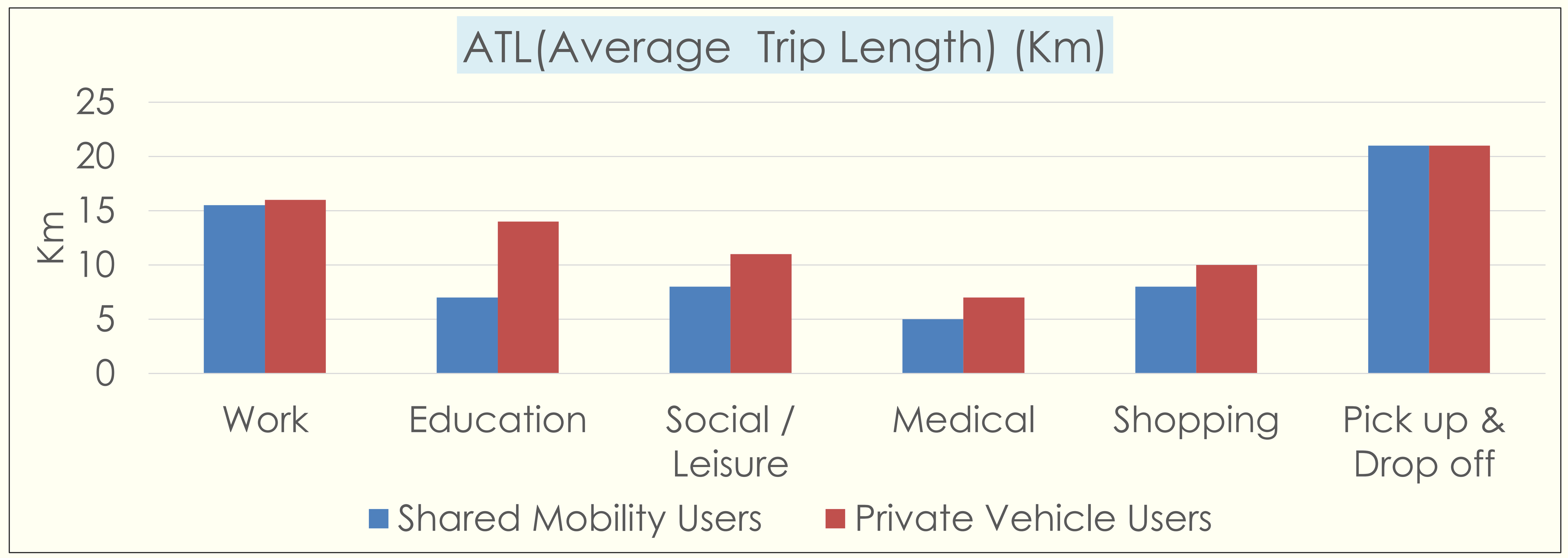
INSTITUTE OF URBAN TRANSPORT (INDIA)

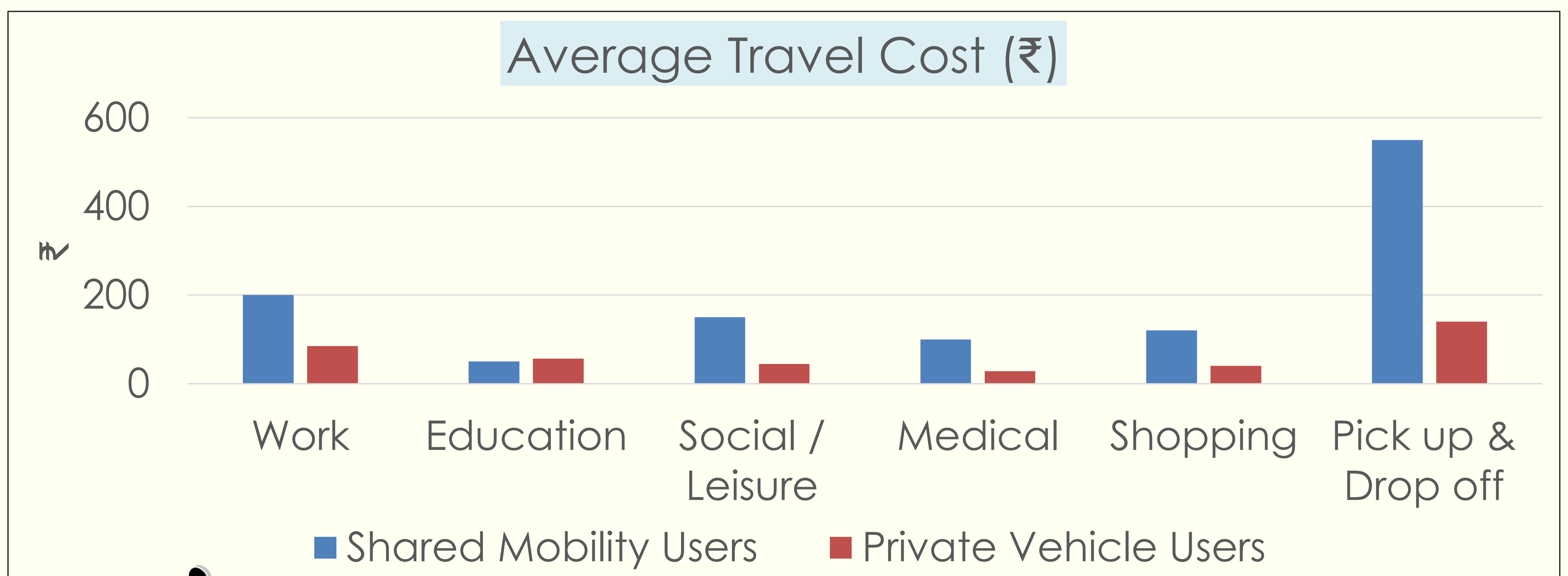
COMPARSION BETWEEN SHARED MOBILITY USER AND PRIAVTE VEHICLE USER

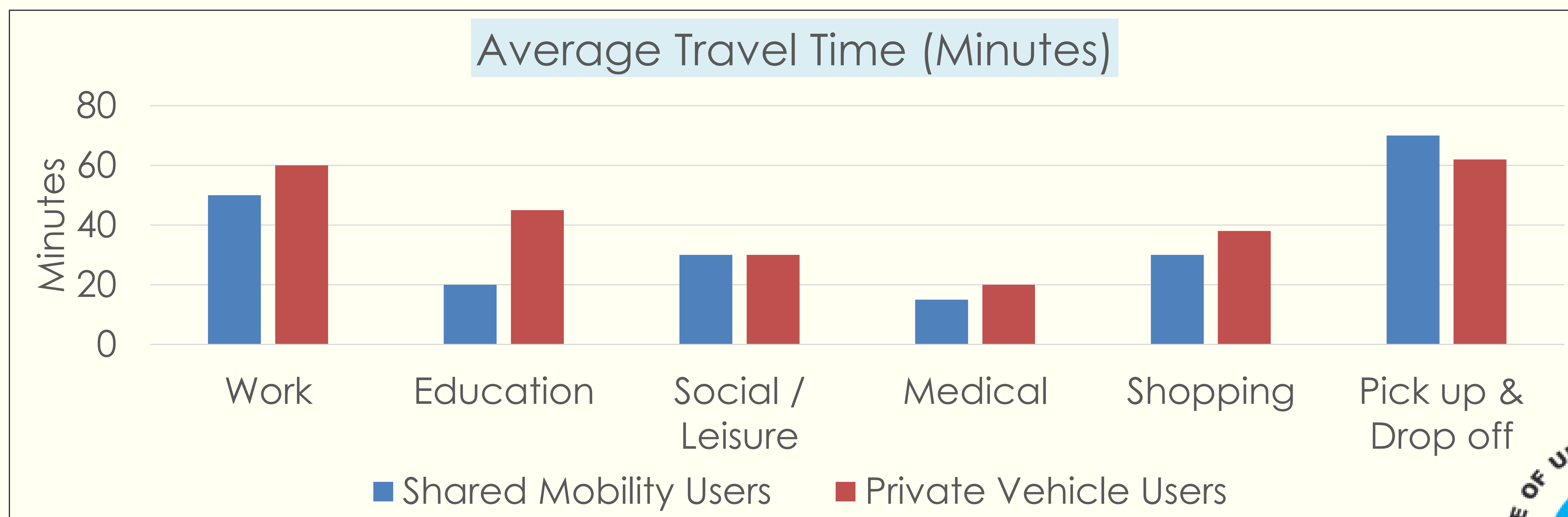
Socio Economic Characteristics

Travel Characteristics



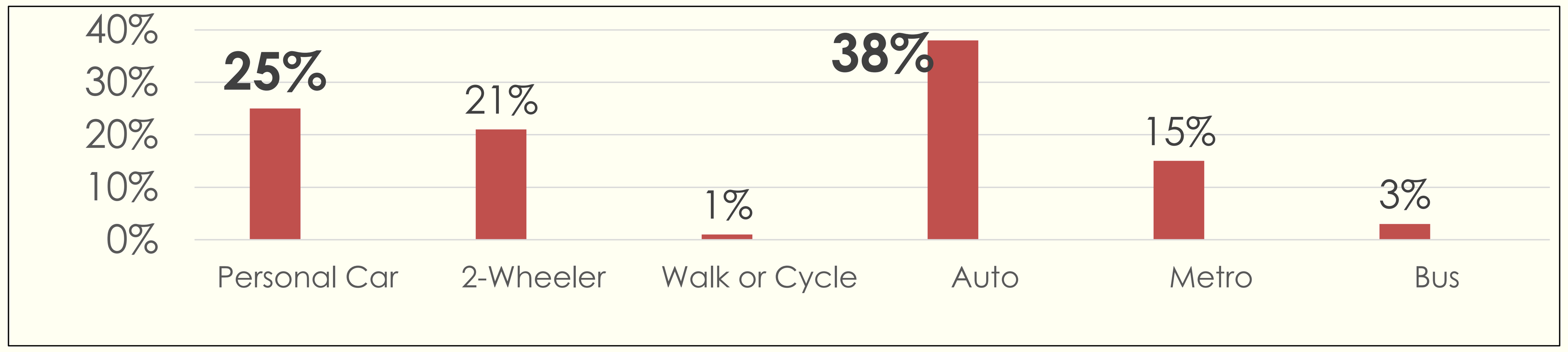


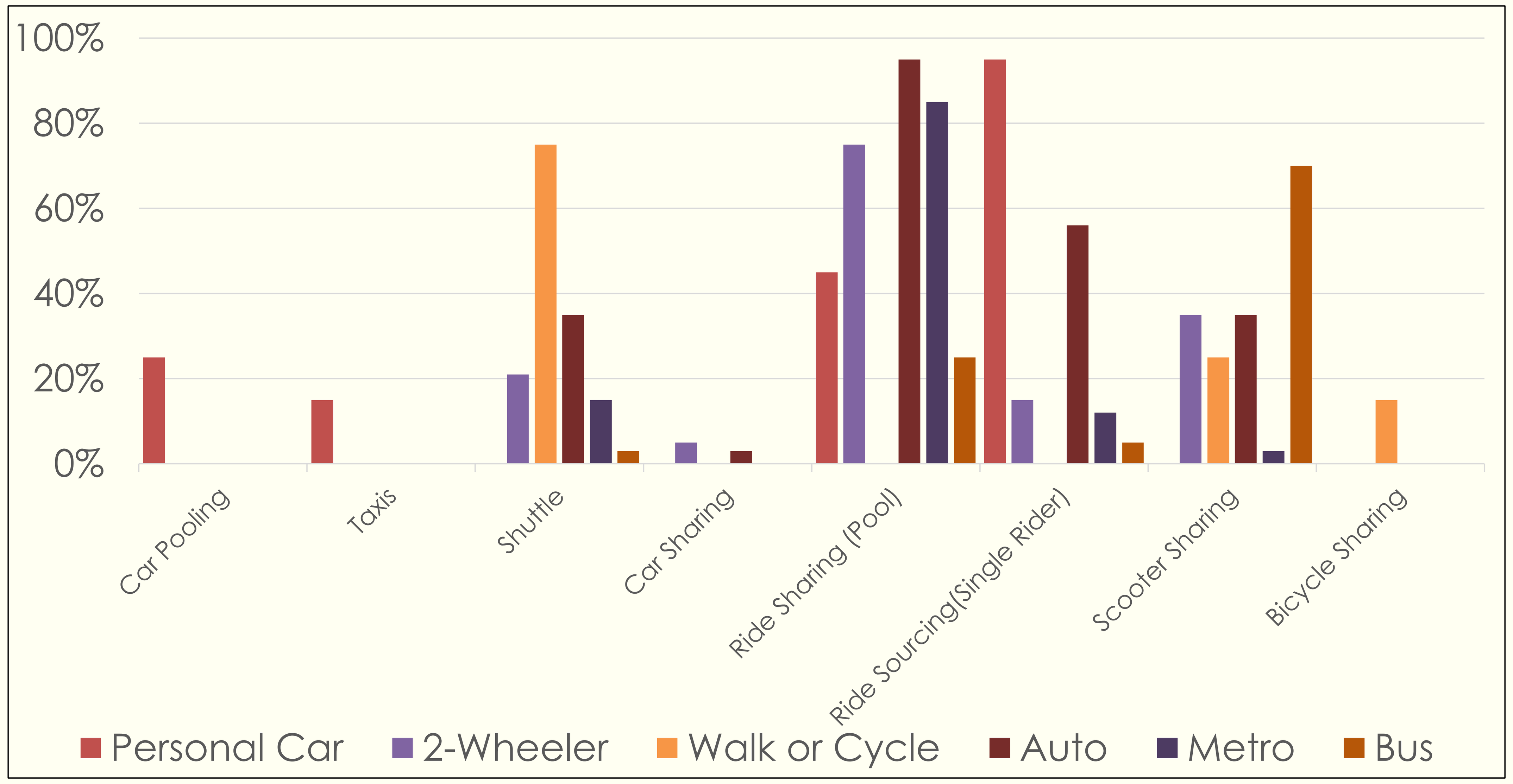




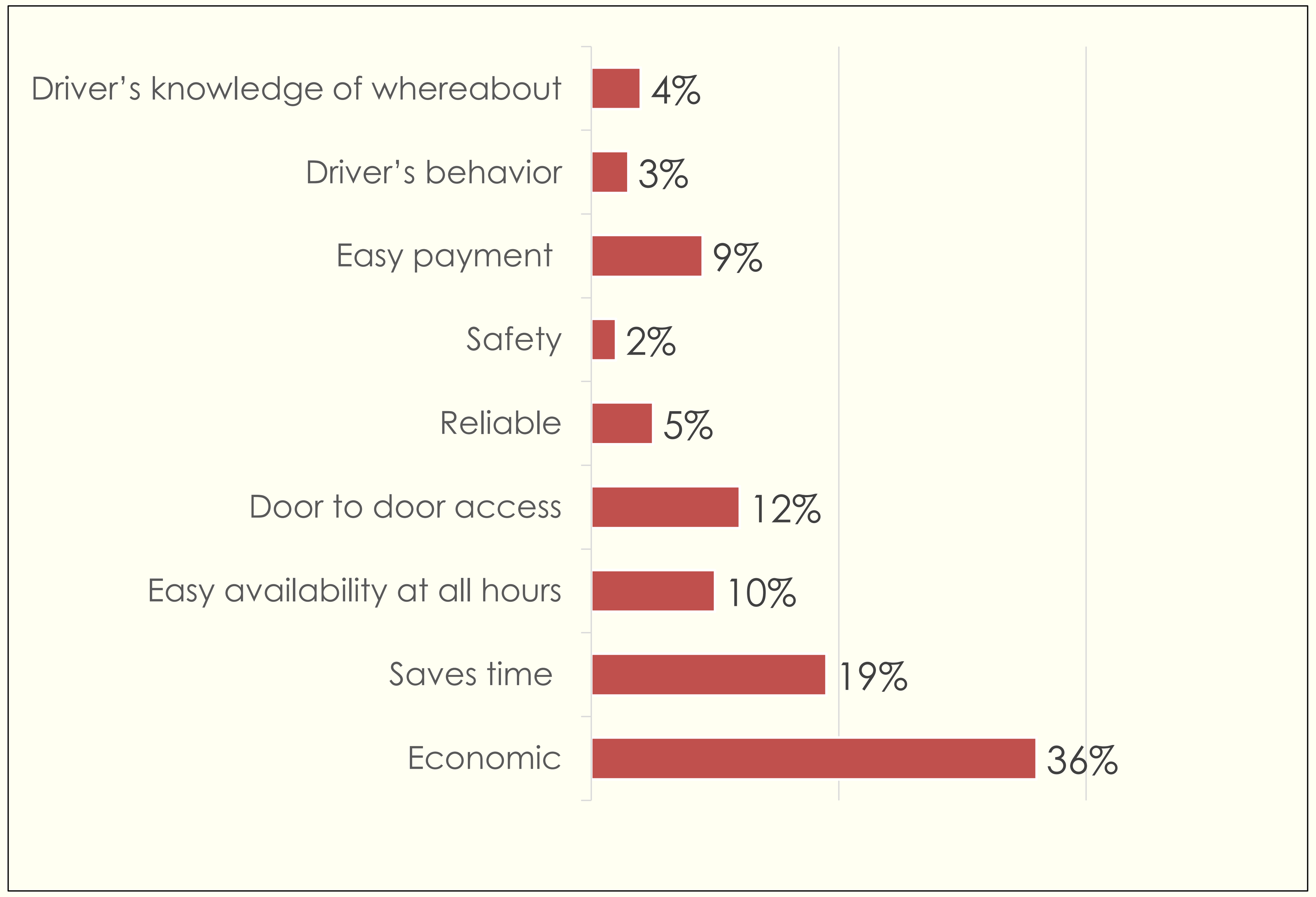
IMPACT OF SHARED MOBILITY ON MOBILITY LEVEL

Mode Used Before Shifting to Shared Mobility





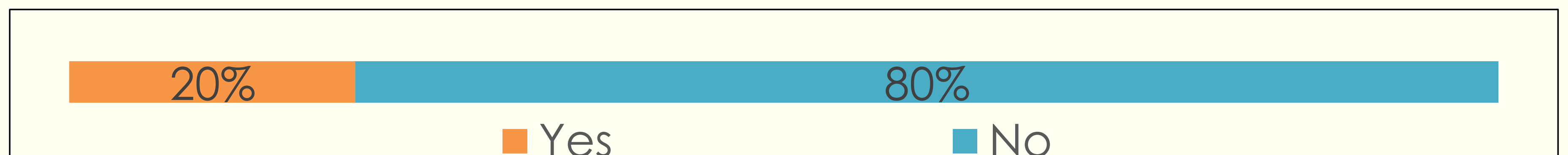
Primary reason to choose Shared Mobility



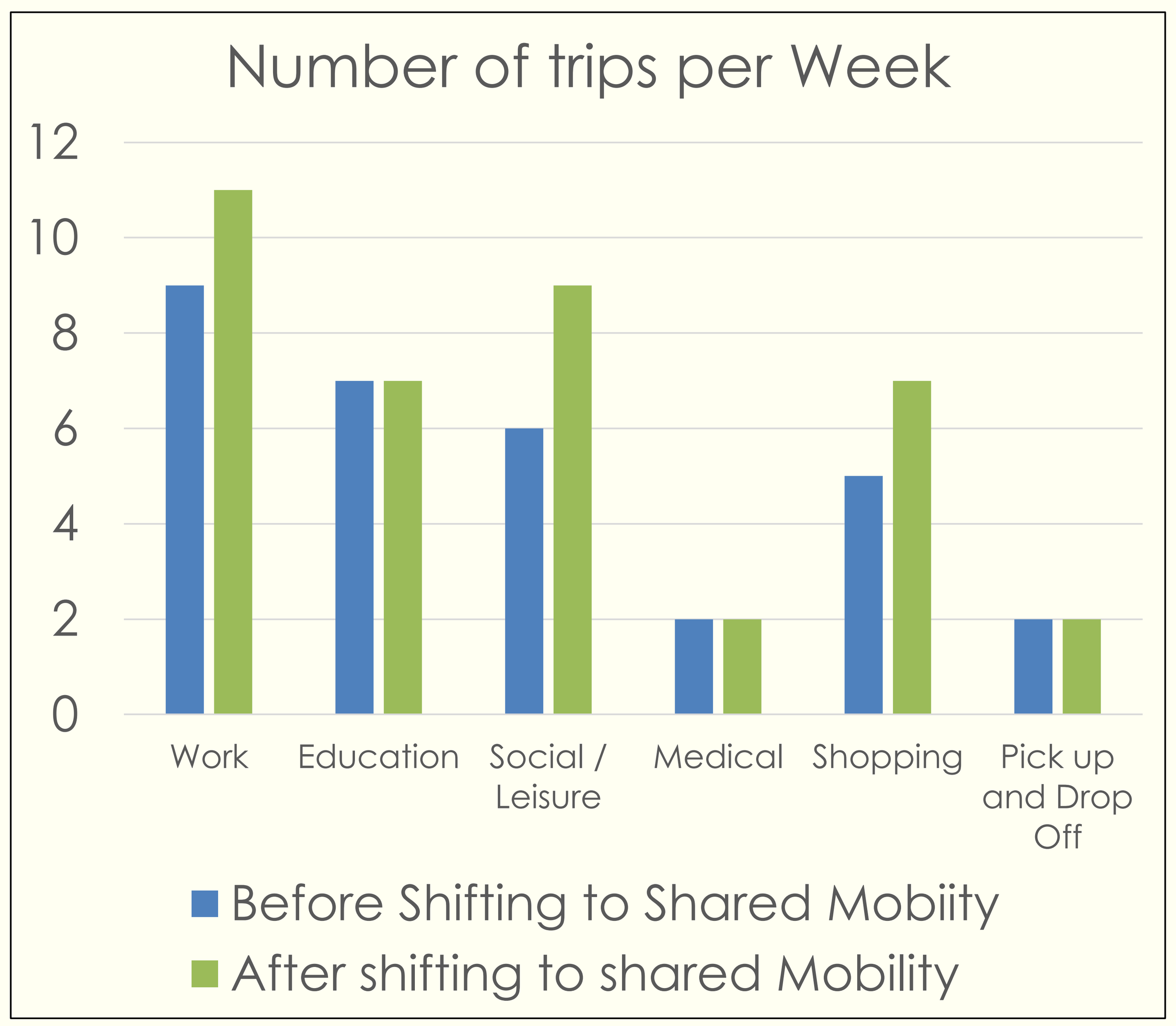
Observation:-

- 38% of SM user were using Auto before because its more economic
- **ATL** has **reduced** after shifting to Shared mobility but **frequency has increases**
- **58%** of the SM user are using SM services for more than **1.5 years**

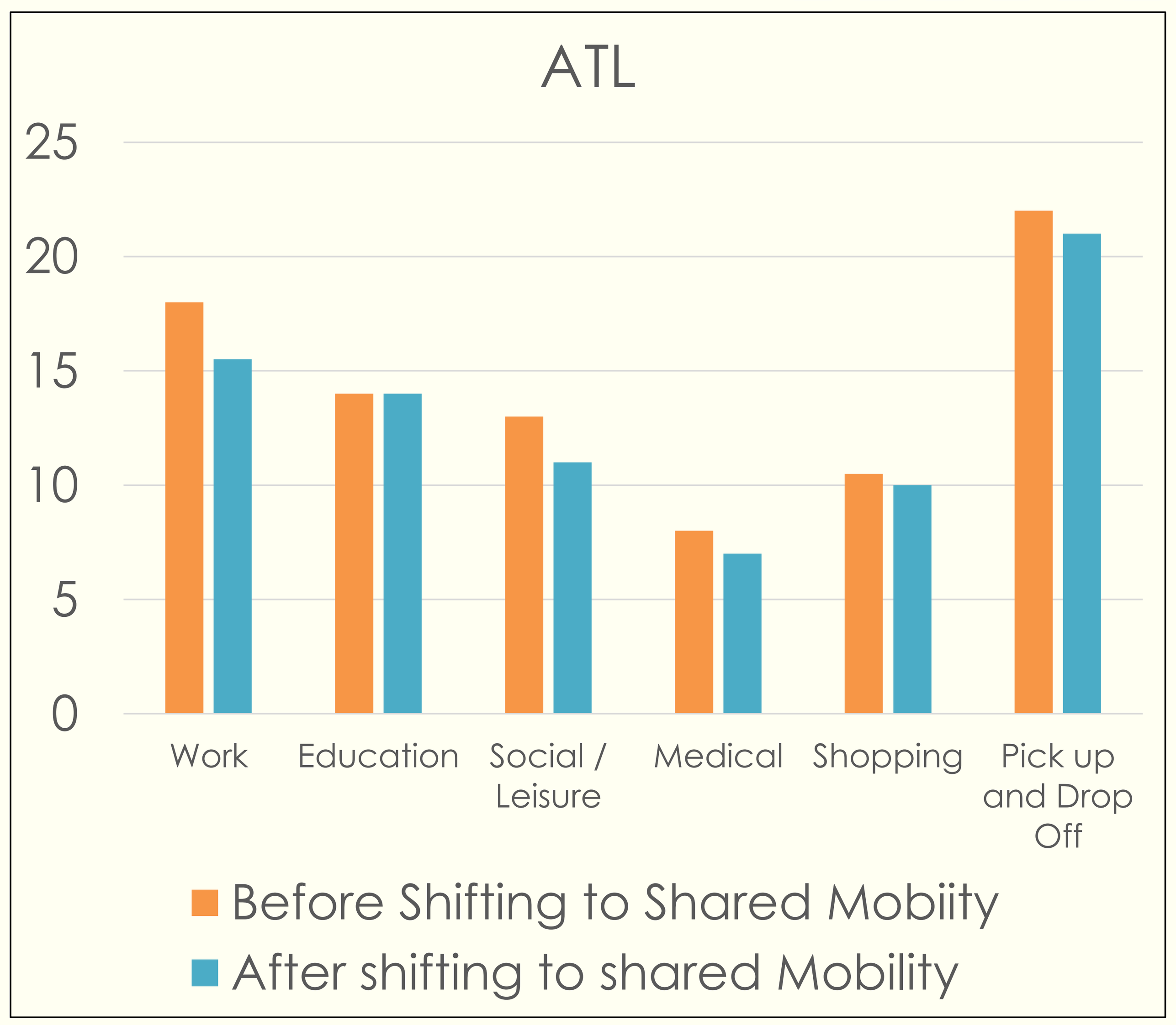
Shared Mobility to reach Metro Station



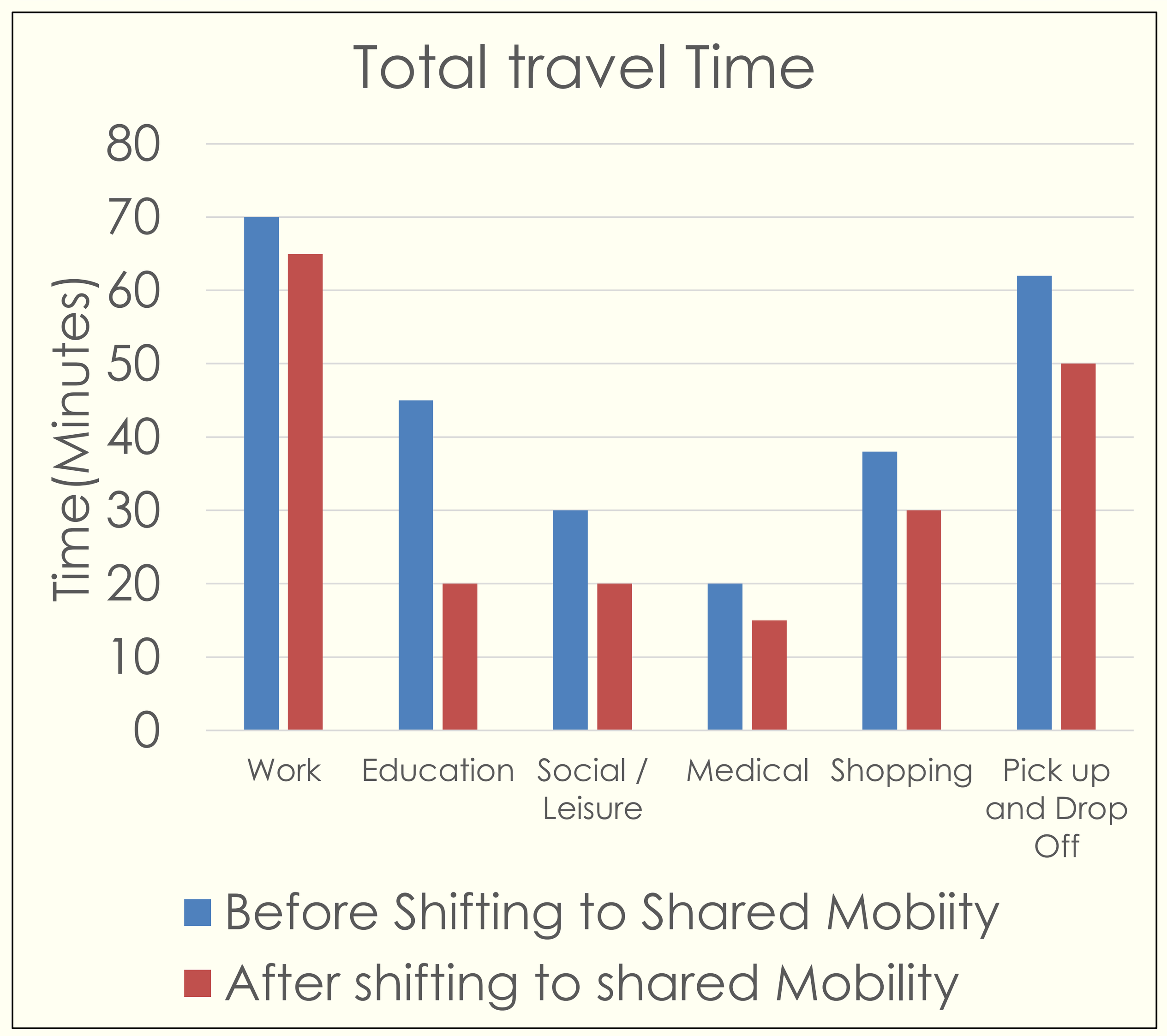
Delay in purchasing a car



Change in no. of trips in Work , Social and Shopping

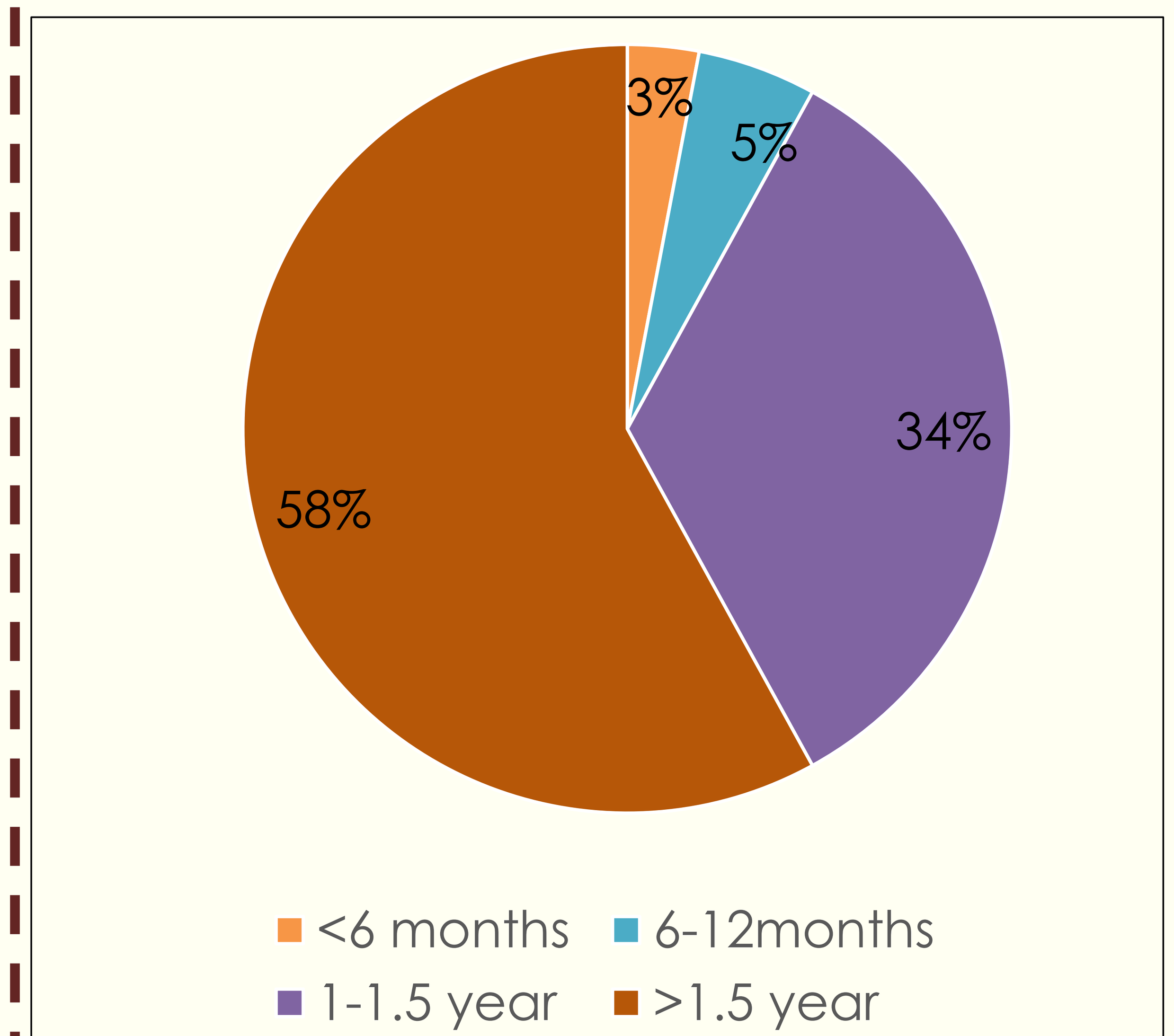


Reduction in Average Trip length(ATL) is seen in all purpose except Education



While calculating total travel time, Waiting time for shared mobility is excluded

Using Shared Mobility



Source : Primary Survey Feb 2018

11th Urban Mobility India Conference & Expo 2018

INSTITUTE OF URBAN TRANSPORT (INDIA)

IMPACT OF SHARED MOBILITY ON MOBILITY PATTERNS

Societal Impacts

Vehicular Reduction

Mode Use Before Shifting

Mode	Passenger Trips	Occupancy	In Vehicles	PCU	**In PCU**
Personal Car	85	1.2	71	1	**71**
2-Wheeler	71	1.12	64	0.5	**32**
Cycle	3	1	3	0.3	**1**
Auto	119	1	119	1	**119**
Metro	51				**-**
Bus	10	34	0	3	**1**
Total	339		257		**223**

Mode Use After Shifting

Mode	Passenger Trips	Occupancy	In Vehicles	PCU	**In PCU**
Car Pooling	37	2	19	1	**19**
Taxis	10	1	10	1	**10**
Shuttle	24	16	1	3	**4**
Car Sharing	14	3	5	1	**5**
Ride Sharing	108	3	36	1	**36**
Ride Sourcing	108	1	108	1	**108**
Scooter Sharing	20	1	20	0.5	**10**
Bicycle Sharing	17	1	17	0.3	**5**
Total	339		217		**198**

Inferences From Panel Survey

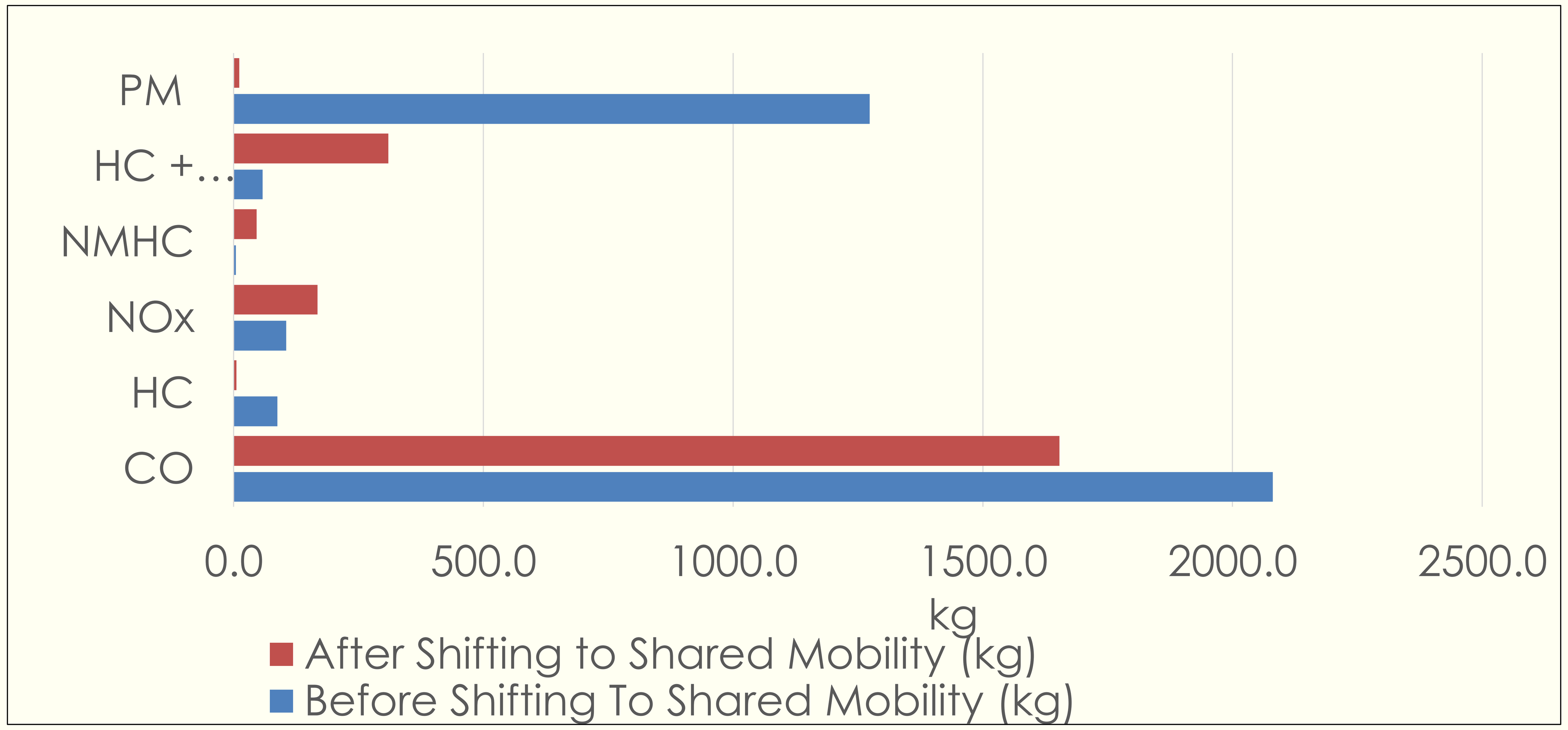
- **Vehicular Reduction** after shifting to Shared Mobility **= (257-181) = 76 Vehicles**
- % change in vehicular Reduction after Shifting to Shared Mobility **= (76*100)/257 = 29%**
- Vehicular Reduction in PCU **= (223-162) = 61 PCU**
- %change in Vehicles **= (61*100)/223 = 27%**

Environmental Impacts

Emission Reduction

Emission Standards

Mode	Fuel	Vehicle Class	CO (g/Km)	HC (g/Km)	NOx (g/Km)	HC +NOx (g/Km)	PM (g/Km)
Scooter	Petrol	2 W (BS IV)	1	0.1	0.06		0.0045
		2 W (B III)	1.2				1.2
Auto	CNG	3 W (BS IV)	0.94	0.44	0.13		0.94
		3 W (BS III)	1.2				1.2
Car	Petrol	4W (BS IV)	1	0.1	0.08	0.17	0.0045
		4W (BS III)	2.3	0.2	0.15		
	Diesel	4W (BS IV)	0.5		0.25	0.3	0.025
		4W (BS III)	0.64		0.5	0.56	0.05
	CNG	4W (BS IV)	1	0.03	0.08	0.17	0.0045
		4W (BS III)	2.3	0.06	0.15		
Mini Bus	Diesel	BS III	0.64		0.5	0.56	0.05
Bus	CNG	BS III	4	1.1	3.5		0.03



Inferences:-

- Major reduction in Emission component is shown CO, HC & PM
- NOx & NMHC are emission component which have increased by 1.5 times & **10.69** times respectively
- There is **reduction in 426kg of CO(Carbon Monoxide) over an year**

IMPACT OF SHARED MOBILITY ON MOBILITY PATTERNS

Benefits at Individual Level

Non User (Private Car user)

New Car-User

- Loan Cost (Down Payment + Loan Principle+ Loan Interest) (if applicable)
- Insurance Cost
- Registration/ taxes
- Annual Maintenance Cost
- **Parking / Miscellaneous Charges**
- **Driver's Salary(if applicable)**
- **Running Cost**
- (-) Resale Value

Old Car-User

- **Parking / Miscellaneous Charges**
- **Driver's Salary(if applicable)**
- **Running Cost**
- (-) Resale Value

Shared Mobility User (Ola & Uber)

Cost of Hiring
Base fare **+** Distance Fare **+** Ride Time Fare

1. **Ride Sourcing**
   - Economy(hatch back)
     - Pool
     - Go
   - Premium Sedan
     - Premier (Sedan)
     - XL (XUV)
2. **Ride Sharing (POOL)**

Source : Author Source

Shared Mobility User

Category	Base Fare	Distance Fare	Ride time Fare	Total Fare	Total Fare for 3 years
Hatch Back	₹ 50	₹ 296	₹ 100	₹ 446	**₹ 4,88,370**
Prime Sedan	₹ 60	₹ 408	₹ 100	₹ 568	₹ 6,21,960
SUV	₹150 for first 4km	₹ 544	₹ 150	₹ 844	₹ 9,24,180

1.Total Cost of owning a Car in 3 years (Petrol)
- Net Cost (With Hired Driver) = **₹10,95,000**
- Net Cost (without Hired Driver) = **₹ 6,63,000**

2.Total Cost of owning a Car in 3 years (Diesel)
- Net Cost (With Hired Driver) = **₹11,40,000**
- Net Cost (without Hired Driver) = **₹7,08,660**

3.Total Cost of owning a Car in 3 years (CNG)
- Net Cost (With Hired Driver) **= ₹10,25,000**
- Net Cost (without Hired Driver) = **₹5,93,000**

New Car-User

Component of Cost	Hatchback		
	Petrol	Diesel	CNG
Cost of Car	5,00,000	6,00,000	5,30,000
Insurance Cost	2.5%	3.0%	3%
Road taxes	4 %	5%	4%
Annual Maintenance Cost	21,000	25,000	35,000
Running Cost (ATL =36 km)	1,66,955	1,06,263	83,220
Parking/ Miscellaneous Charges	37,000	37,000	37,000
Hired Driver (if applicable)	4,32,000	4,32,000	4,32,000
Resale Value	2,34,000	2,00,000	2,00,000

Net Cost for New Non User = **[Cost of Car + Insurance Cost + Road Taxes + Annual Maintenance Cost + Running Cost + Parking/ Miscellaneous Charges + Hired driver(if applicable) – Resale Value]**

Category	Shared Mobility User	New Private Vehicle Users (Petrol) with Driver	New Private Vehicle Users (Petrol) without Driver	Old Car User (Petrol) with Driver
Hatch Back	**₹ 4,88,370**	**₹10,95,000**	**₹ 6,63,000**	**₹5,95,000**

ISSUES IDENTIFIED

USER ISSUES :-

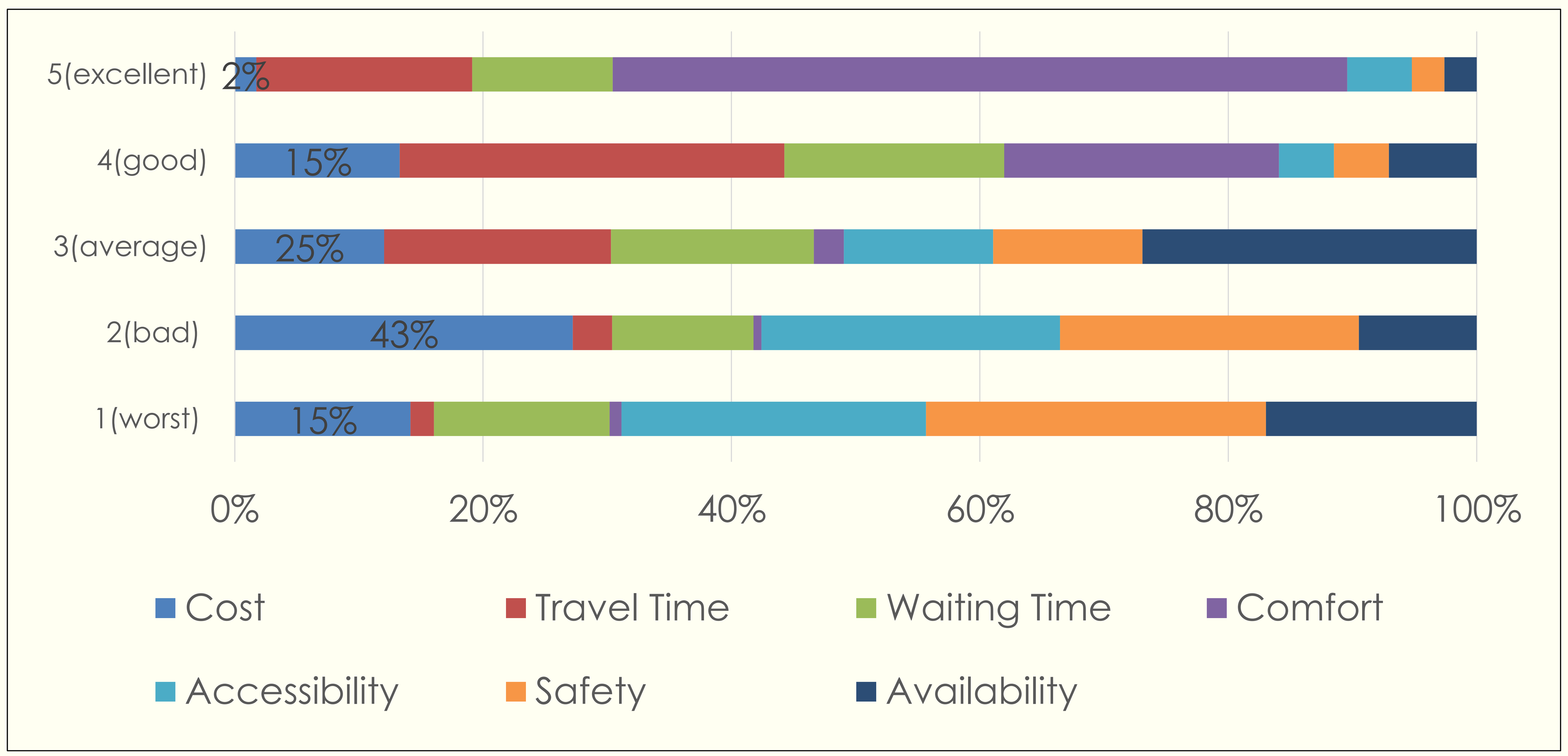
Ride Sourcing

- **58%** of the users have **Cost issue**
- **33%** of the users have **Waiting time issue**
- **64%** of the users have **Accessibility issue**
- **35%** of the user have rated worst in terms of **safety**

Ride Sharing

- **68 %** of users have said **Cost** is the major issue for choosing ride Sharing
- **63%** of the have rated **Waiting Time Issue**
- **86%** of the user said **Travel time** is shared mobility is high

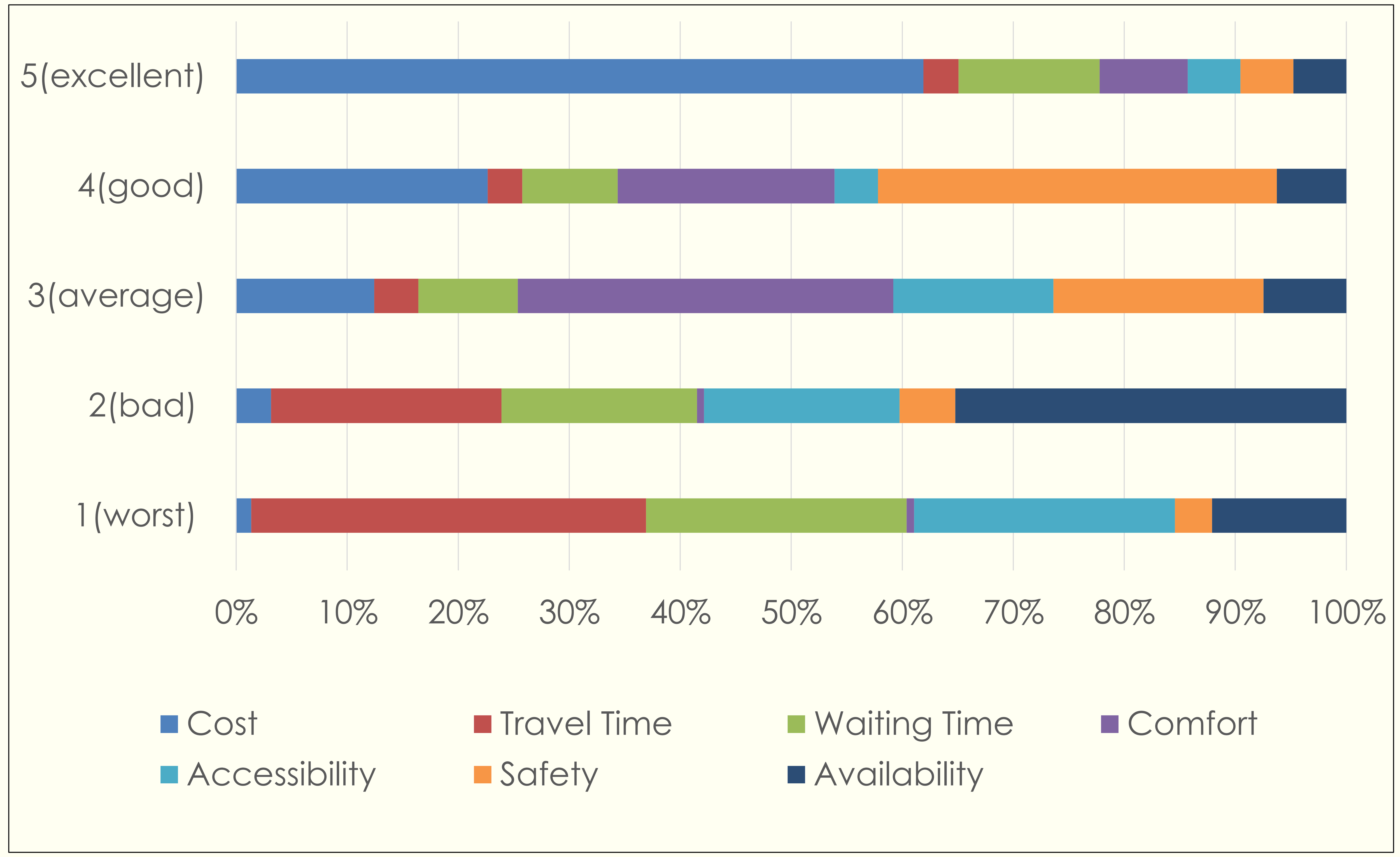
Ride Sourcing



NON-USER ISSUES :-

- 39% of Non-User says shared mobility is costly
- 24 % of Non-User high waiting
- 15% of Non-user says Non availability
- Women Safety

Ride Sharing



OPERATORS ISSUES :-

- Additional distance need to travel in Ola Pool & Uber Pool
- Cancellation of rides at Last moment
- Absence of Pickup and drop off points at Commercial Area
- Fluctuation in bonus in completion of operational target trips
- Cashless payments
- Parking

Other Issues :-

- Drivers Knowledge about the Road and reading GPS
- Waiting Time Shown in App is not accurate
- Pickup Point Issues
- Dead Mileage is high in Uber pool & Ola Share
- Payment Issues
- Surge Price
- Cancellation fee & Cancellation of trips from both operator and Passenger side
- Parking Near Commercial & Institutional Area

MODELLING CHOICE FOR SHARED MOBILITY

- **Different scenarios** are generated in terms **of saving of using various attributes with different level** and presented to respondent in the form of a choice set
- In Total 6 scenario are selected using the best combination of **Realistic, Optimistic and Pessimistic Savings** of attributes
- Attributes are:-
  1. **In-vehicle time**
  2. **Waiting time**

  } Shared Mobility User Attributes

  3. **Parking Search Time**
  4. **Parking Cost**

  } Non User Attributes(Car)
- Using these Attributes with different Scenario we generate **Utility equation** using **SIMPLE BINARY LOGIT MODEL**

Actual Values	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Normal Car	0	38	5	50
Ride Sourcing	7	38	0	0
Ride Sharing	10	58	0	0

Savings

Ride Sourcing	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Realistic	7	0	-5	-50
Optimistic	4	-2	-10	-100
Pessimistic	9	2	-3	-10

Ride Sharing	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Realistic	10	20	-5	-50
Optimistic	5	11	-10	-100
Pessimistic	13	16	-3	-38

The **Binary Logit Model** is used for Predicting mode choice Probability of Ride Sharing and Car. The Following Equations are used for the Calculation:-

$$\text{Probability of Choosing Ride Sharing } (P_{RS}) = \frac{e^{Utility\ of\ Ride\ Sharing}}{e^{Utility\ of\ Ride\ Sharing} + e^{Car}} = \frac{e^{U_{TR}}}{e^{U_{TR}} + e^{U_{TC}}}$$

$$\text{Probability of Choosing Ride Sharing } (P_{RS}) = \frac{e^{Car}}{e^{Utility\ of\ Ride\ Sharing} + e^{Car}} = \frac{e^{U_{TC}}}{e^{U_{TR}} + e^{U_{TC}}}$$

Scenarios Building

Scenarios	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Scenario1	Realistic	Realistic	Realistic	Realistic
Scenario2	Optimistic	Optimistic	Optimistic	Optimistic
Scenario3	Pessimstic	Pessimstic	Pessimstic	Pessimstic
Scenario4	Realistic	Optimistic	Optimistic	Pessimstic
Scenario5	Optimistic	Pessimstic	Realistic	Optimistic
Scenario6	Optimistic	Realistic	Pessimstic	Realistic

Ride Sharing	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Scenario1	10	20	-5	-50
Scenario2	5	11	-10	-100
Scenario3	13	16	-3	-38
Scenario4	10	11	-10	-38
Scenario5	5	16	-5	-100
Scenario6	5	20	-3	-50

Ride Sourcing	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)
Scenario1	7	0	-5	-50
Scenario2	4	-2	-10	-100
Scenario3	9	2	-3	-38
Scenario4	7	-2	-10	-38
Scenario5	4	2	-10	-100
Scenario6	4	0	-5	-50

Source : Author Source

MODELLING CHOICE FOR SHARED MOBILITY

Binary Logit Regression Analysis Ride Sharing

Utility Equation $U_T = -1.612 - 0.17(WT) - 0.006(INVT) + 0.03$ (Parking Search Time) + 0.054 (Parking Cost)

				Mode	Ridership(%)
$U_{T\,R}$	-3.005	$e^{U_{T\,RS}}$	0.0495	**Ride Sharing**	**27.3**
$U_{T\,C}$	-2.026	$e^{U_{T\,C}}$	0.1318	**Car**	**72.7**

Probability of choosing Ride sharing = **0.273**

Probability of choosing Car =**0.727**

Binary Logit Regression Analysis Ride Sourcing

Utility Equation UT = -2.010-0.113(WT)- 0.002(INVT) + 0.078(Parking Search Time) + 0.198(Parking Cost)

				Mode	Ridership(%)
UT R	-4.903	eUT R	0.0074	**Ride Sourcing**	**4.6**
UT C	-1.863	eUT C	0.15519	**Car**	**95.4**

Probability of choosing Ride sharing =0.46

Probability of choosing Car =0.954

OVERALL UTILITY OF SHARED MOBILITY

Utility Equation UT = - 0.389-0.23(WT) - 0.029(INVT) + 0.096(Parking Search Time) - 0.018(Parking Cost)

				Mode	Ridership(%)
UT R	-3.0022	eUT R	0.049687	**Shared Mobility**	**29.4**
UT C	-2.1242	eUT C	0.119529	**Car**	**70.6**

Probability of choosing Shared Mobility **= 0.294**

Probability of choosing Private Car **=0.706**

Source : Author Source

SENSTIVITY ANALYSIS

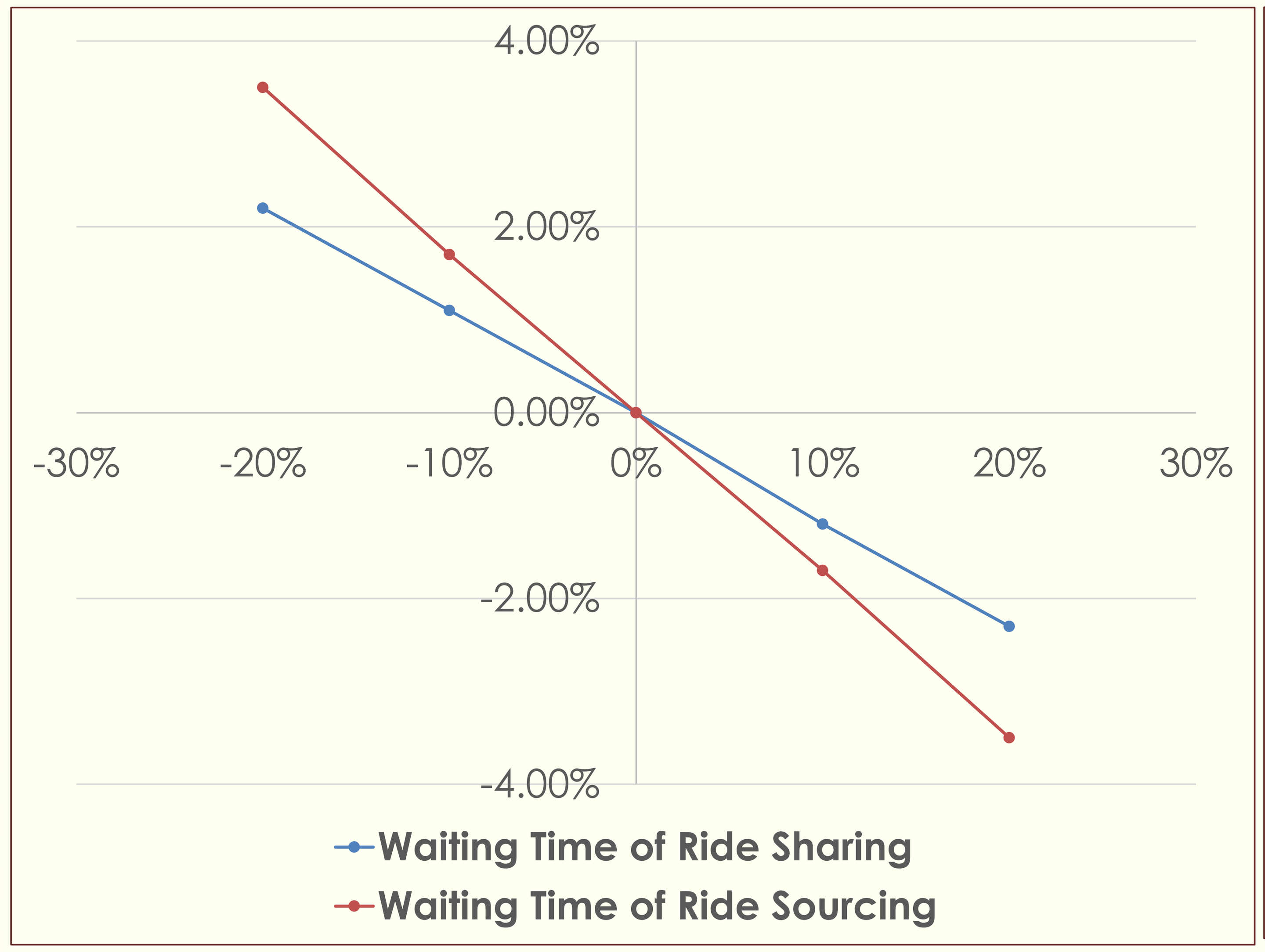
Scenarios	Waiting Time (min)	In vehicle Time (min)	Parking Search Time (min)	Parking Cost (₹)	Probability of Shift to Shared Mobility
Scenario 1	Realistic	Realistic	Realistic	Realistic	1.2 %
Scenario 2	Optimistic	Optimistic	Optimistic	Optimistic	20.5 %
Scenario 3	Pessimistic	Pessimistic	Pessimistic	Pessimistic	0 %
Scenario 4	Realistic	Optimistic	Optimistic	Pessimistic	1 %
Scenario 5	Optimistic	Pessimistic	Realistic	Optimistic	5 %
Scenario 6	Optimistic	Realistic	Pessimistic	Realistic	1.7 %

%Change in Probability of Ride Sharing					
% Change in Attribute	Waiting Time	In vehicle Time	Parking Search Time	Parking Cost	All
-20%	2.2%	0.4%	-2.80%	-3.30%	2.0%
-10%	1.1%	0.2%	-1.40%	-1.60%	1.1%
0%	0.0%	0.0%	0.00%	0.00%	0.0%
10%	-1.2%	-0.2%	1.40%	1.60%	-1.2%
20%	-2.3%	-0.4%	2.70%	3.20%	-2.3%

%Change in Probability of Ride Sourcing					
% Change in Attribute	Waiting Time	In vehicle Time	Parking Search Time	Parking Cost	All
-20%	3.5%	0.20%	-0.9%	-3.70%	3.5%
-10%	1.7%	0.10%	-0.4%	-1.80%	1.7%
0%	0.0%	0.00%	0.0%	0.00%	0.0%
10%	-1.7%	-0.15%	0.4%	1.80%	-1.7%
20%	-3.5%	-0.18%	0.9%	3.50%	-3.5%

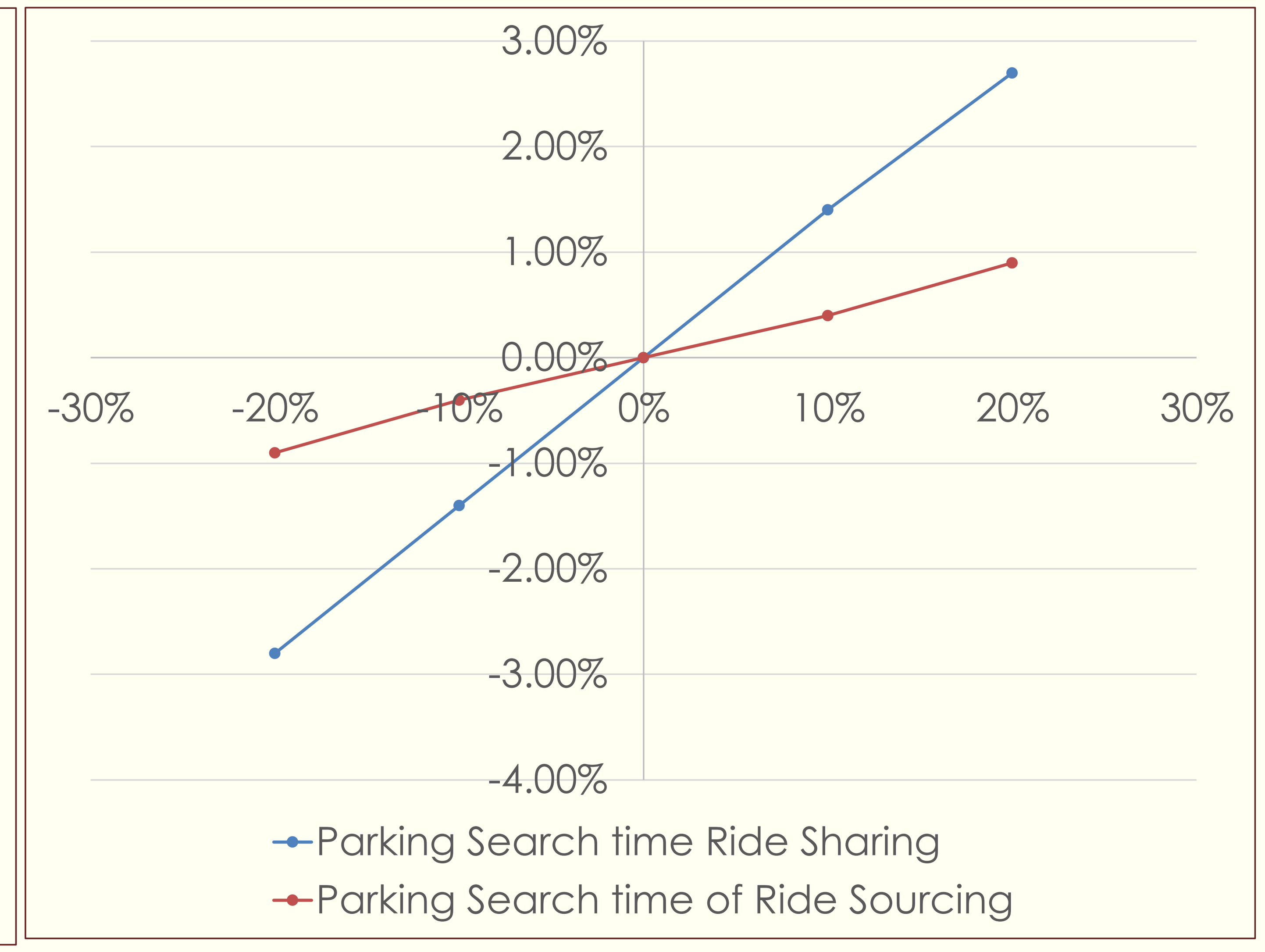
Comparison between Ride Sourcing(Single Rider) and Ride Sharing (Pool)

Waiting Time



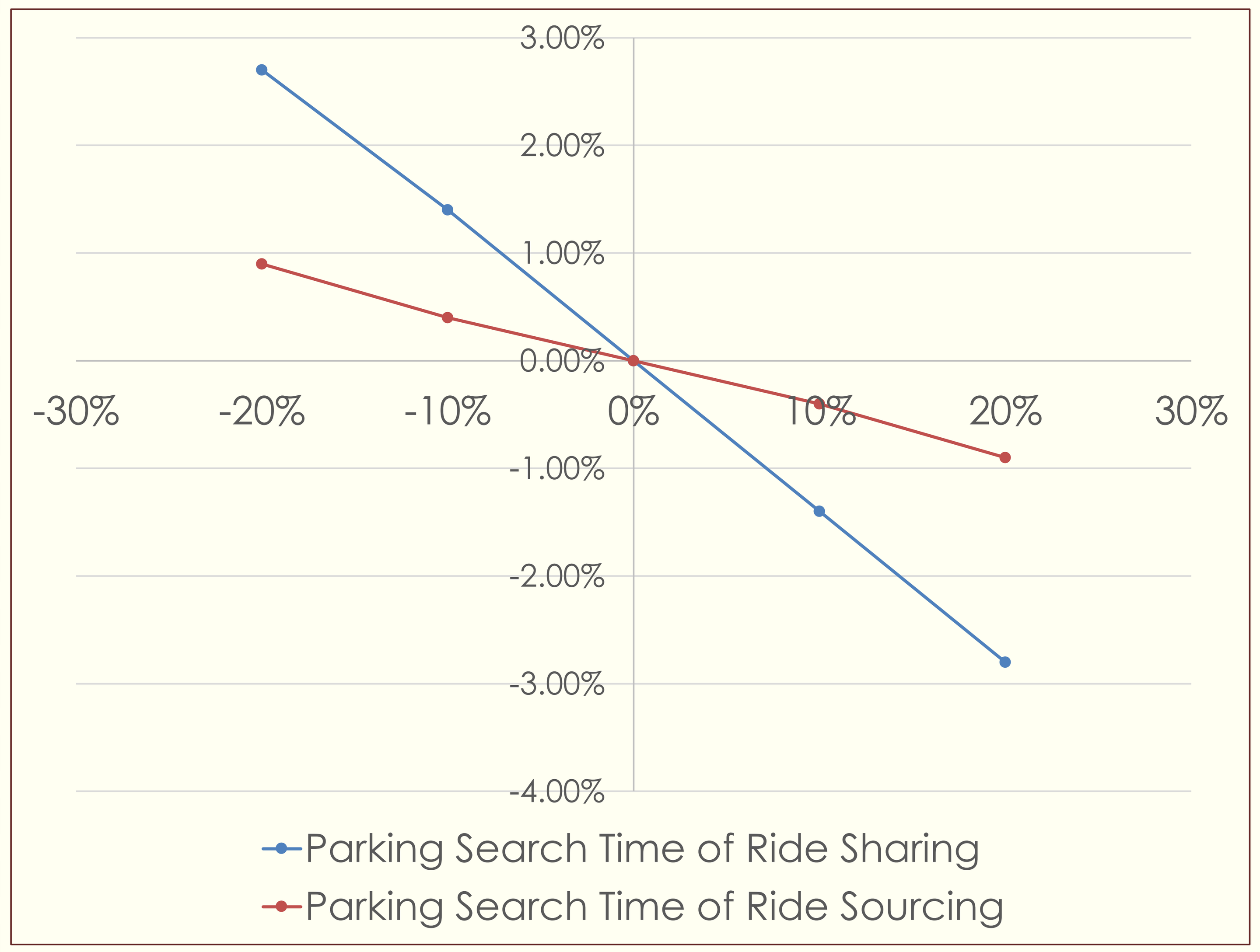
With 10% increase in Waiting time, Ridership Decrease in Ride Sourcing is more comparison to Ride Sharing

Parking Search Time



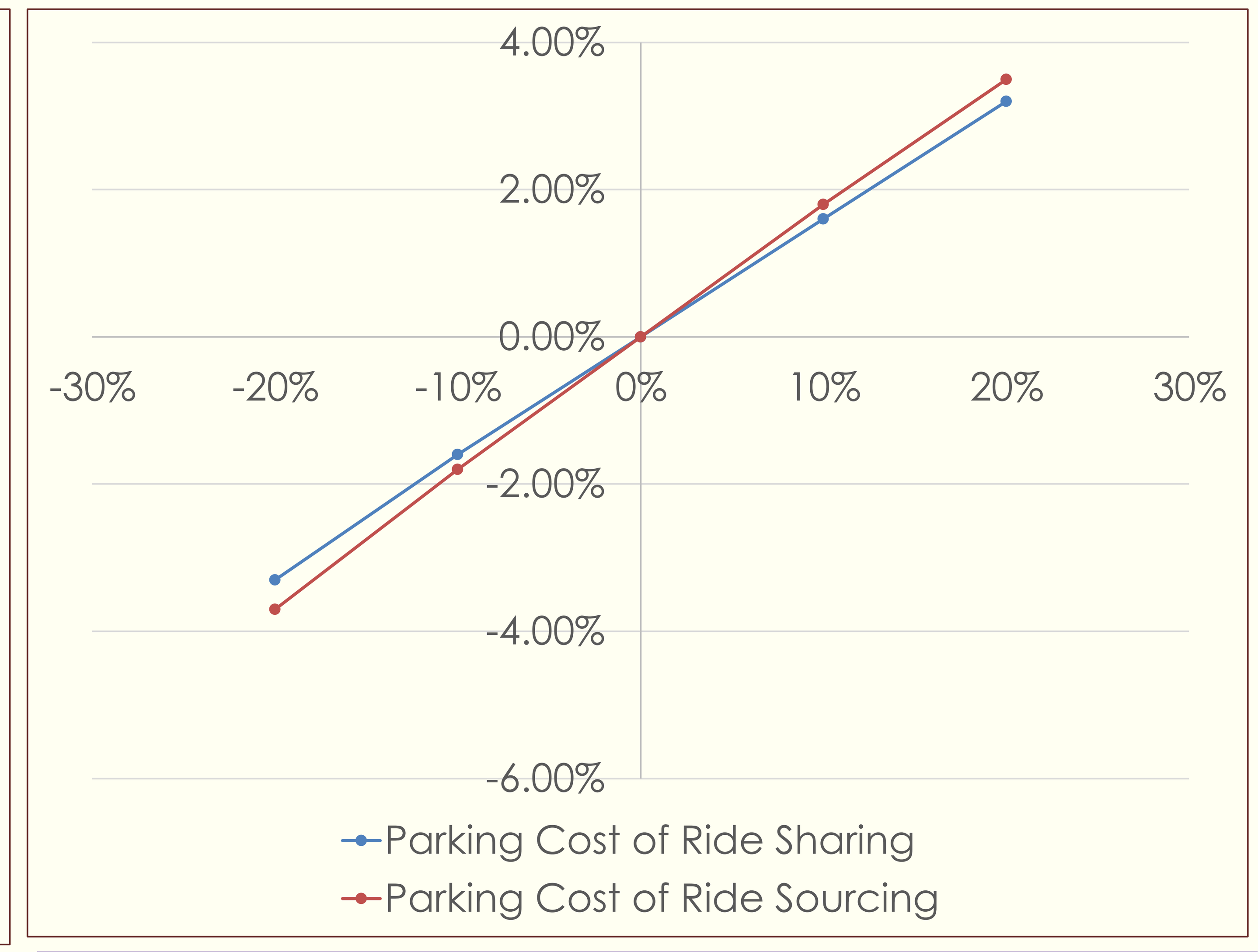
With 10% increase in Parking Search time, Ridership Increase in Ride Sharing is more comparison to Ride Sourcing

In Vehicle Time



With 10% increase in In-Vehicle time, Ridership Decrease in Ride Sharing is more comparison to Ride Sourcing

Parking Cost



With 10% increase in Parking Search time, Ridership Increase in Ride Sourcing is more comparison to Ride Sharing

Source : Author Source

IMPACT OF CHOICE MODELLING OF SHARED MOBILITY

Vehicular Reduction

				Occupancy	1.2	3	
		21%	4.68	29.40%	13%	87%	
Zones	**Population (2001)**	**Car Ownership/ Modal Share**	**VEHICULAR TRIPS Over All Daily Person Car Trip Rates**	**% of Shift to Shared Mobility**	**PASSENGER TRIPS Ride Sourcing**	**PASSENGER TRIPS Ride Sharing (Pool)**	**Vehicular trips**
Zone D	5,87,000	1,23,270	5,76,904	1,69,610	22,049	4,42,681	67,561
Zone F	17,17,000	3,60,570	16,87,468	4,96,115	64,495	12,94,861	1,97,619
Zone G	16,29,000	3,42,090	16,00,981	4,70,688	61,190	12,28,497	1,87,491
Zone H	16,01,300	3,36,273	15,73,758	4,62,685	60,149	12,07,607	1,84,303
Total	55,34,300	11,62,203	54,39,110	15,99,098	2,07,883	41,73,647	6,36,974
Reduction in number of Vehicles on Road			**9,62,124**				
Vehicular Trips Before Shifting			54,39,110				
Vehicular Trips After Shifting			44,76,986				
Actual Vehicular Reduction on Road			9,62,124				
% Actual Vehicular Reduction on Road			**17.69%**				

Source : Transport Demand Forecast Study, RITES(2010), Author Source

Emission Reduction

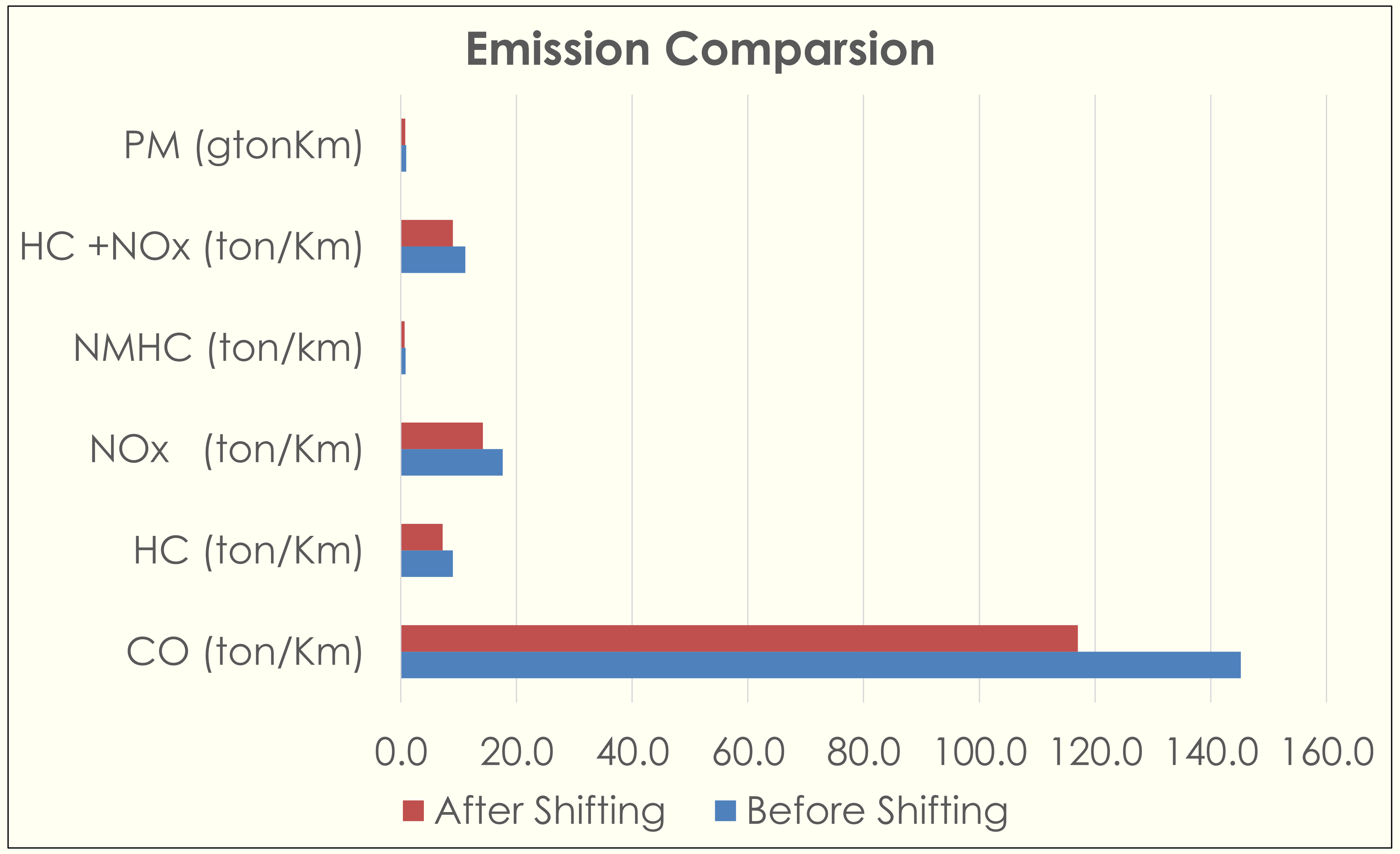
Before Shifting		**Vehicle Class**	**CO (ton/Km)**	**HC (ton/Km)**	**NOx (ton/Km)**	**NMHC (ton/km)**	**HC +NOx (ton/Km)**	**PM (tonKm)**
Car	Petrol	4W (BS IV)	5.7	0.6	0.5	0.0	1.0	0.0
		4W (BS III)	96.6	8.4	6.3	0.0	0.0	0.0
	Diesel	4W (BS IV)	1.1	0.0	0.6	0.0	0.7	0.1
		4W (BS III)	10.5	0.0	8.2	0.0	9.2	0.8
	CNG	4W (BS IV)	1.7	0.0	0.1	0.1	0.3	0.0
		4W (BS III)	29.5	0.0	1.9	0.8	0.0	0.0
	Total		**145.2**	**9.0**	**17.6**	**0.8**	**11.1**	**0.9**

After Shifting		**Vehicle Class**	**CO (ton/Km)**	**HC (ton/Km)**	**NOx (ton/Km)**	**NMHC (ton/km)**	**HC +NOx (ton/Km)**	**PM (tonKm)**
Car	Petrol	4W (BS IV)	4.6	0.5	0.4	0.0	0.8	0.0
		4W (BS III)	77.9	6.8	5.1	0.0	0.0	0.0
	Diesel	4W (BS IV)	0.9	0.0	0.5	0.0	0.5	0.0
		4W (BS III)	8.5	0.0	6.6	0.0	7.4	0.7
	CNG	4W (BS IV)	1.4	0.0	0.1	0.0	0.2	0.0
		4W (BS III)	23.8	0.0	1.6	0.6	0.0	0.0
	Total		**117.1**	**7.2**	**14.2**	**0.7**	**9.0**	**0.7**

Overall Utility

Probability of choosing Shared Mobility = **0.294**

Probability of choosing Car =**0.706**



CONCLUSION

Analysis	Findings	Conclusions
STUDY OF SOCIO-ECONOMIC CHARACTERISTICS OF SHARED MOBILITY USERS	• Majority of the shared mobility users are male, above 18years old, at least under graduated with an income range lies between **₹25,000 to ₹1,00,000 (57%)**	• Safety is the one of the issue because of which female shared mobility users are less.
STUDY OF TRAVEL CHARACTERISTICS OF SHARED MOBILITY USERS	• 67% of the shared mobility users are using ride sharing and ride sourcing as the primary source of travel majorly for work purpose(46%) followed by social purpose (20%) with an average ATL of 14.88km • Economic (36%) and time savings (19%) are the primary reason to shared mobility as mode of travel	• Many people are ready to use the Shared mobility on a regular basis (work purpose) although a separate booking is to be made each and every day. • As compared to a private mode, shared mobility is a more economical option to the user as well as having an advantage in time savings.
IMPACT OF SHARED MOBILITY USERS ON MOBILITY LEVELS	• Mode use shared mobility user before shifting to shared mobility are Auto (38%) followed by personal Car (25%) and 21% (2-W) • Shared mobility has enhance the mobility pattern of the users as number of trips made per week for work and social has shown a significant change.	• 29 % of Vehicular reduction has taken after shifting to Shared mobility • Emission reduction of 426 kg/km of CO & 1262 kg/km of PM , 63kg/km of NO_X and 252kg/km of (HC+ NO_X) have been observed over a year for the sample collected
MODE CHOICE MODELLING	• Mode choice modelling for shared mobility is performed using attributes In-Vehicle time, Waiting Time, Parking search time and Parking Cost. • Probability of car users willing to shift is 29.4% • Sensitivity analysis is performed and we find out Non users are more sensitive to waiting time and Parking Cost	• 17.8% of vehicular reduction • Emission reduction of 28 ton/km of CO & 0.2 ton/km of PM , 3.4 ton/km of NO_X and 2.1 ton/km of (HC+ NO_X) have been observed over a year for the sample collected

Recommendations

- Minimising of Waiting time can be done by using Upper Level model by increasing the income of driver and increasing Fleet Size
- Zoning Operation area can also reduce waiting time. Because of shorter trips, further reduction in dead mileage travelled by the driver can be achieved.
- In vehicle time can be reduced by providing HOV(High Vehicle Occupancy lane)

THANK YOU

IMPACT OF SHARED MOBILITY ON MOBILITY PATTERNS

Shared Mobility Impacts

The Potential Impacts of Shared Mobility can be :-

1. Environmental Impacts

- Lower greenhouse gas emissions
- Improved air quality
- Increased transit ridership

2. Social Impacts

- Reduce Congestion
- Improved Health
- House Cost Saving

3. Economic Impacts

- Reduced Infrastructure and maintenance

The shared mobility Impacts can also be categories as :-

1. **Societal Impacts** – Those are Impacting at society level
2. **Individual Impacts** - Those are Impacting at individual level (Users or Operators)

Methodology for Calculation Emission

Sample of different modes with different purposes

↓

ATL(Average Trip Length) of different mode with different purpose is taken

↓

Number of trips made per Week (predominate user & Mixed User)

↓

VKT/person/ week is Calculated for Each Mode

↓

Emission Standards Values are taken from **ARAI Emission Norms** for each mode for different Class of vehicles

↓

Emitted Emission for each class of Vehicle is then Calculated

Emission Standards

Mode	Fuel	Vehicle Class	CO (g/Km)	HC (g/Km)	NOx (g/Km)	HC +NOx (g/Km)	PM (g/Km)
Scooter	Petrol	2 W (BS IV)	1	0.1	0.06		0.0045
		2 W (B III)	1.2				1.2
Auto	CNG	3 W (BS IV)	0.94	0.44	0.13		0.94
		3 W (BS III)	1.2				1.2
Car	Petrol	4W (BS IV)	1	0.1	0.08	0.17	0.0045
		4W (BS III)	2.3	0.2	0.15		
	Diesel	4W (BS IV)	0.5		0.25	0.3	0.025
		4W (BS III)	0.64		0.5	0.56	0.05
	CNG	4W (BS IV)	1	0.03	0.08	0.17	0.0045
		4W (BS III)	2.3	0.06	0.15		
Mini Bus	Diesel	BS III	0.64		0.5	0.56	0.05
Bus	CNG	BS III	4	1.1	3.5		0.03

Source : ARAI emission norms

Societal Impacts

Mode Use Before Shifting

Mode	Passenger Trips	Occupancy	In Vehicles	PCU	In PCU
Personal Car	85	1.2	71	1	71
2-Wheeler	71	1.12	64	0.5	32
Cycle	3	1	3	0.3	1
Auto	119	1	119	1	119
Metro	51	0			0
Bus	10	34	0	3	1
Total	339		257		**223**

Mode Use After Shifting

Mode	Passenger Trips	Occupancy	In Vehicles	PCU	In PCU
Car Pooling	37	2	19	1	19
Taxis	10	1	10	1	10
Shuttle	24	16	1	3	4
Car Sharing	14	3	5	1	5
Ride Sharing	108	3	36	1	36
Ride Sourcing	108	1	108	1	108
Scooter Sharing	20	1	20	0.5	10
Bicycle Sharing	17	1	17	0.3	5
Total	339		217		**198**

Inferences:-

- **Vehicular Reduction** after shifting to Shared Mobility **= (257-181) = 76 Vehicles**
- % change in vehicular Reduction after Shifting to Shared Mobility **= (76*100)/257 = 29%**
- Vehicular Reduction in PCU **= (223-162) = 61 PCU**
- %change in Vehicles **= (61*100)/223 = 27%**

Source : Author Source

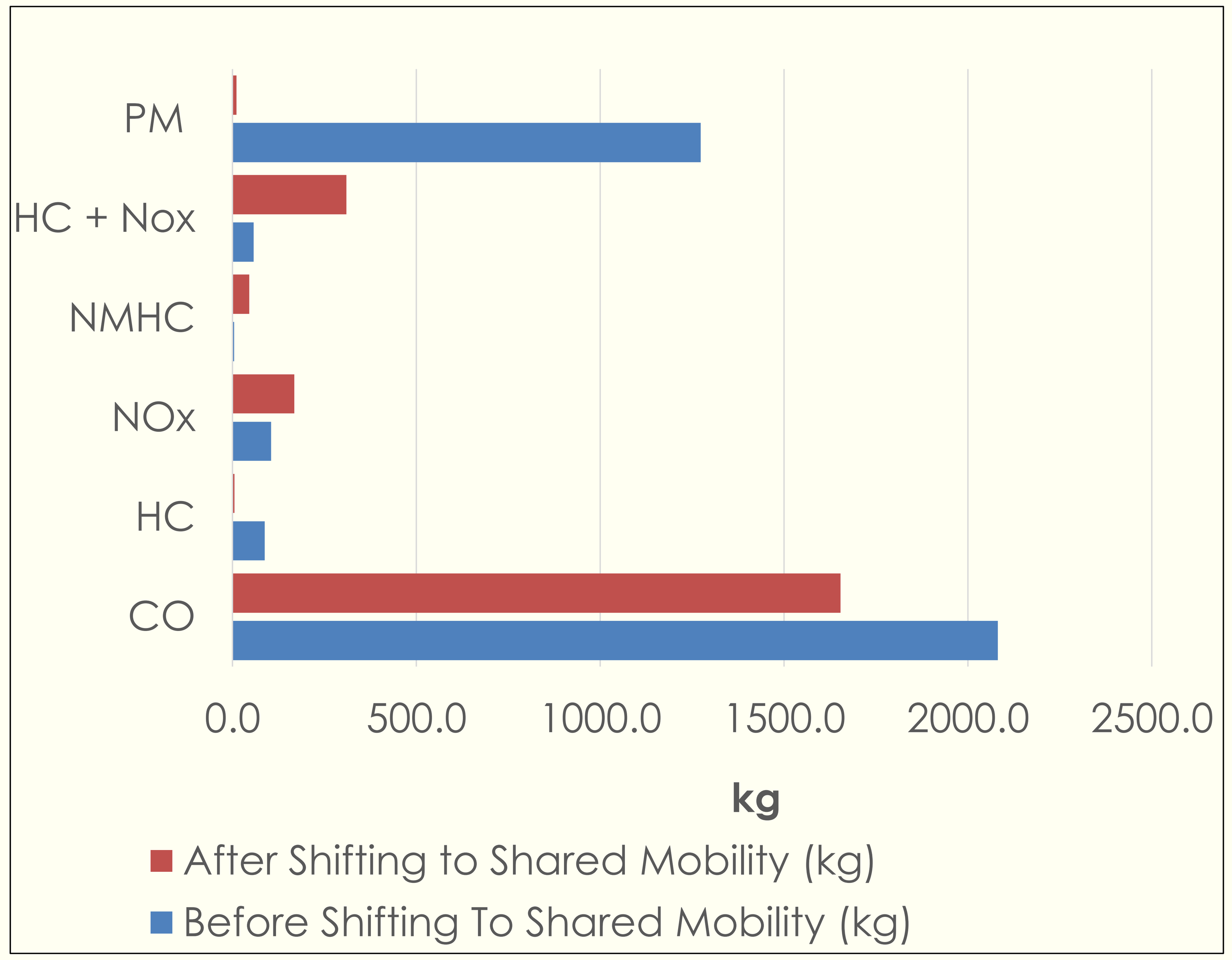
IMPACT OF SHARED MOBILITY ON MOBILITY PATTERNS

Societal Impacts

Emission for Different Mode Before Shifting

Mode	Fuel	Vehicle Class	CO (kg/Km)	HC (kg/Km)	NOx (kg/Km)	NMHC (kg/km)	HC +NOx (kg/Km)	PM (kg/Km)
Scooter	Petrol	2 W (BS IV)	56.0	5.6	3.4	0.0	0.0	0.3
		2 W (B III)	492.7	0.0	0.0	0.0	0.0	492.7
Auto	CNG	3 W (BS IV)	74.9	35.0	10.4	0.0	0.0	74.9
		3 W (BS III)	700.8	0.0	0.0	0.0	0.0	700.8
Car	Petrol	4W (BS IV)	29.9	3.0	2.4	0.0	5.1	0.1
		4W (BS III)	503.5	43.8	32.8	0.0	0.0	0.0
	Diesel	4W (BS IV)	5.8	0.0	2.9	0.0	3.5	0.3
		4W (BS III)	54.6	0.0	42.7	0.0	47.8	4.3
	CNG	4W (BS IV)	9.1	0.0	0.7	0.3	1.5	0.0
		4W (BS III)	153.6	0.0	10.0	4.0	0.0	0.0
	Total		**2080.9**	**87.4**	**105.3**	**4.3**	**57.9**	**1273.4**

Emission Comparison



Consideration :-

- Emission are Calculated for 1 year of the mode use before and after shifting to shared Mobility
- Idling Emission through vehicles are not considered in Calculation
- Major reduction in Emission component is shown CO, HC & PM
- NOx & NMHC are emission component which have increased by 1.5 times & **10.69** times respectively
- There is reduction in 426kg of CO(Carbon Monoxide) over an year

Emission for Different Mode After Shifting

Mode	Fuel	Vehicle Class	CO (kg/Km)	HC (kg/Km)	NOx (kg/Km)	NMHC (kg/km)	HC +NOx (kg/Km)	PM (kg/Km)
Bike	Petrol	2 W (BS IV)	52	5	3	0	0	0
		2 W (B III)	0	0	0	0	0	0
Car	Petrol	4W (BS IV)	0	0	0	0	0	0
		4W (BS III)	0	0	0	0	0	0
	Diesel	4W (BS IV)	56	0	28	0	34	3
		4W (BS III)	0	0	0	0	0	0
	CNG	4W (BS IV)	1527	0	122	46	260	7
		4W (BS III)	0	0	0	0	0	0
Mini Bus	Diesel	BS III	19	0	14	0	16	1
Bus	CNG	BS III	0	0	0	0	0	0
	Total		**1654**	**5**	**168**	**46**	**309**	**11**

Benefits at Individual Level

Non User (Private Car user)

New Car-User

- Loan Cost (Down Payment + Loan Principle+ Loan Interest) (if applicable)
- Insurance Cost
- Registration/ taxes
- Annual Maintenance Cost
- **Parking / Miscellaneous Charges**
- **Driver's Salary(if applicable)**
- **Running Cost**
- (-) Resale Value

Old Car-User

- **Parking / Miscellaneous Charges**
- **Driver's Salary(if applicable)**
- **Running Cost**
- (-) Resale Value

Shared Mobility User (Ola & Uber)

Cost of Hiring
Base fare **+** Distance Fare **+** Ride Time Fare

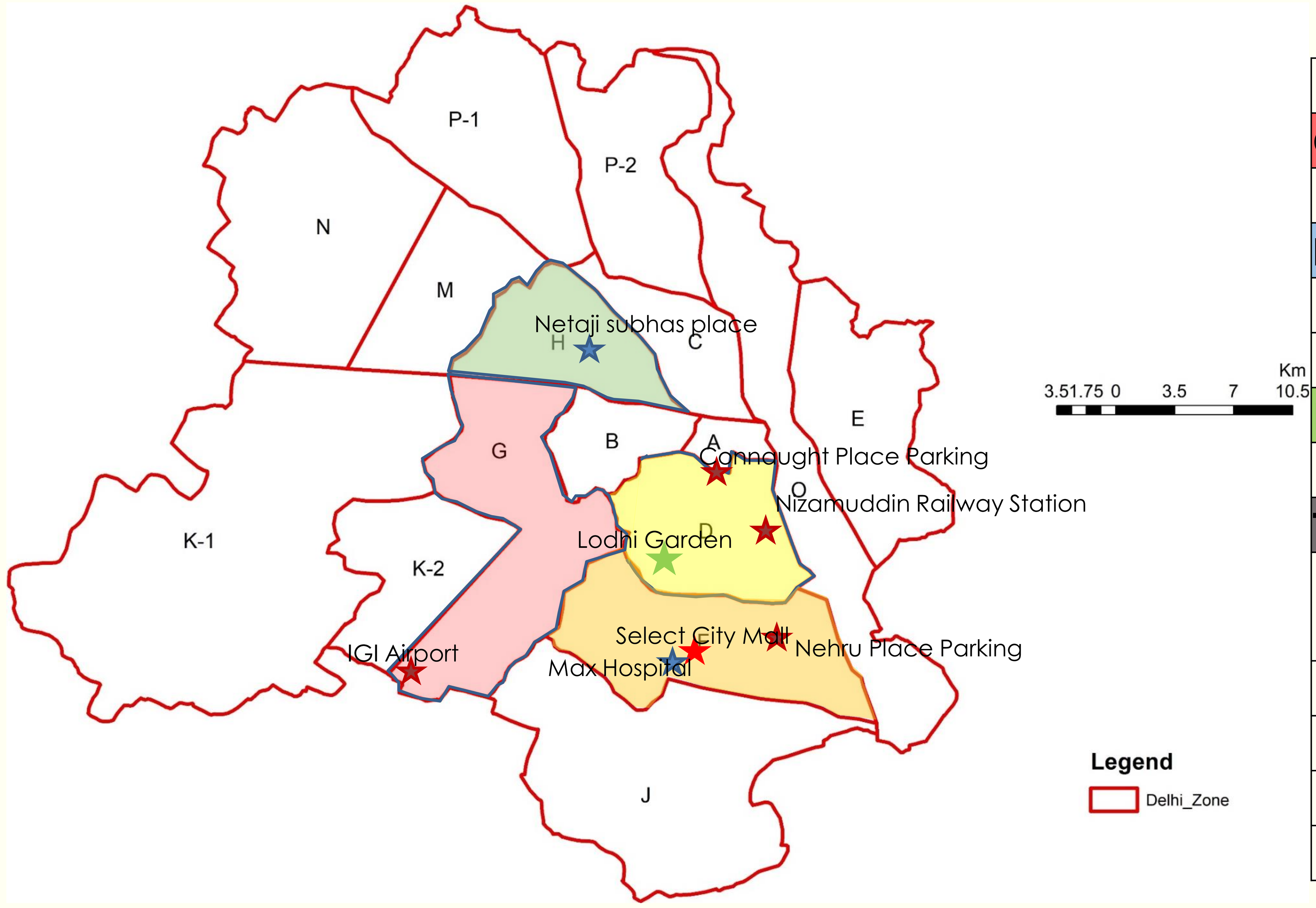
1. **Ride Sourcing**
   Economy(hatch back)
   Pool
   Go
   Premium Sedan
   Premier (Sedan)
   XL (XUV)
2. **Ride Sharing (POOL)**

Source : Author Source

MODELLING CHOICE FOR SHARED MOBILITY)

★ (dark red)	Transportation LU
★ (red)	Commercial LU
★ (blue)	Institutional LU
★ (green)	Recreational LU

Zone	% Sample
D	20%
F	25%
G	20%
H	35%
Total	100%



Location	Sample Size	% Sample
Commercial Land Use		
Select City Mall, Saket	10	10%
Institutional Land Use		
Max hospital, Saket	5	5%
IT Sector	35	35%
Recreational Land Use		
Lodhi Garden	6	6%
Transportation land Use		
Nizamuddin Railway Station	4	4%
Connaught Place Parking	10	10%
Nehru Place Parking	10	10%
IGI Airport	20	20%
Total	100	100%

Socio- Economic Characteristics

Description	Total	By Gender		By Age Group					By Monthly Income					
		Male	Female	Upto 18 yrs	18-25 yrs	25-35 yrs	35-50 yrs	Above 50 yrs	Up to ₹10,000	₹10,000 -25,000	₹25,000-50,000	₹50,000-1,00,000	Above ₹1,00,000	NA
Sample Size	100	74	26	0	36	43	16	5	0	9	23	35	10	23
Distribution by age														
Up to 18 yrs	0%	0%	0%							0%	0%	0%	0%	0%
18-25 yrs	36%	20%	33%							54%	15%	0%	0%	75%
25-35 yrs	43%	40%	64%							35%	45%	30%	10%	25%
35-50 yrs	16%	35%	3%							11%	40%	70%	40%	0%
Above 50 yrs	5%	5%	0%							0%	0%	0%	50%	0%
Distribution by Gender														
Male	74%				45%	90%	85%	100%		90%	72%	85%	100%	40%
Female	26%				55%	10%	15%	0%		10%	28%	15%	0%	60%
Distribution by Monthly Income														
Upto ₹10,000	0%			0%	0%	0%	0%	0%						
₹10,000-25,000	9%			0%	25%	5%	0%	0%						
₹25,000-50,000	23%			0%	12%	32%	25%	0%						
₹50,000-1,00,000	35%			0%	0%	47%	70%	0%						
Above ₹1,00,000	10%			0%	0%	3%	5%	100%						
NA	23%			0%	63%	13%	0%	0%						

Travel Characteristics

Average Fare(₹)	284
Average In-Vehicle Time (Min)	49
Average Waiting Time (Min)	0
Average Income(₹/month)	52000

Purpose	ATL	% Share
Work	21 km	42%
Education	14 km	2%
Social / Leisure	11 km	27%
Medical	7 km	13%
Shopping	10 km	14%
Pick up and Drop Off	25 km	2%
Mean ATL	14.88 km	
Average Speed	24 km/hr	

Source : Primary Survey, feb 2018 & CSE Study,2017

MODELLING CHOICE FOR SHARED MOBILITY

Binary Logit Regression Analysis Ride Sharing

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	34.789	2	.000
	Block	34.789	2	.000
	Model	34.789	2	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	**297.069a**	**0.019**	**0.04**

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	11.946	8	**.154**

Classification Table

Observed		Predicted		
		Response		Percentage Correct
		0	1	
Response	0	147	12	92.5
	1	23	70	93.0
Overall Percentage				86%

Variables in the Equation s

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1	WT	**+0.03**	0.002	20.906	1	**0.03**	1.030	.986	1.994
	INVT	**-0.006**	0.001	42.009	1	**0.05**	.994	0.994	0.998
	Parking_ST	**-0.017**	0.10	23.012	1	**0.02**	1.030	0.983	1.012
	Parking_C	**-.054**	.020	16.033	1	**0.001**	.947	0.947	1.260
	Constant	**-1.612**	1.792	16.664	1	**0.001**	1.106		

Utility Equation **U_T = -1.612-0.17(WT)- 0.006(INVT) + 0.03(Parking Search Time) + 0.054(Parking Cost)**

						Mode	Ridership(%)
U_{TR}	=	-3.005	$e^{U}{}_{TRS}$	=	0.0495	Ride Sharing	27.3
U_{TC}	=	-2.026	$e^{U}{}_{TC}$	=	0.1318	Car	72.7

Probability of choosing Ride sharing =**0.273**

Probability of choosing Car =**0.727**

Binary Logit Regression Analysis Ride Sourcing

Omnibus Tests of Model Coefficients

			Chi-square	df	Sig.
Step 1	Step	Step	33.374	2	
	Block	Block	33.374	2	
	Model	Model	33.374	2	

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	210.433a	.05	**0.123**

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	12.649	8	**.125**

Classification Table

Observed		Predicted		
		Response		Percentage Correct
		0	1	
Response	0	178	6	96.7
	1	51	17	25.0
Overall Percentage				**77.4**

Variables in the Equation s

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1	WT	**-0.113**	0.01	6.906	1	**0.024**	0.893	0.893	1.994
	INVT	**+0.078**	.035	17.514	1	**0.038**	1.081	1.081	1.115
	Parking_ST	**-0.002**	.076	21.135	1	**0.35**	0.984	0.984	0.998
	Parking_C	**+0.198**	.005	2.555	1	**0.05**	1.218	.960	1.583
	Constant	**-2.010**	2.454	3.416	1	**.065**	-12.327		

Utility Equation **U_T = -2.010-0.113(WT)- 0.002(INVT) + 0.078(Parking Search Time) + 0.198(Parking Cost)**

						Mode	Ridership(%)
UT R	=	-4.903	eUT R	=	0.0074	**Ride Sourcing**	**4.6**
UT C	=	-1.8631	eUT C	=	0.15519	**Car**	**95.4**

Probability of choosing Ride sharing =**0.46**

Probability of choosing Car =**0.954**

OVERALL UTILITY OF SHARED MOBILITY

Utility Equation **UT = -0.389-0.23(WT)-0.029(INVT)+0.096(Parking Search Time) -0.018(Parking Cost)**

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	**87.24**	**0.027**	**0.035**

						Mode	Ridership(%)
U_{TR}	=	-3.0022	$e^{U}{}_{TR}$	=	0.049687	Shared Mobility	**29.4**
U_{TC}	=	-2.1242	$e^{U}{}_{TC}$	=	0.119529	Car	**70.6**

Probability of choosing Shared Mobility = **0.294**

Probability of choosing Car =**0.706**

Source : Author Source

PROPOSALS

1(a) Waiting Time Reduction by using Upper Level Model

- It aims at improving the reliability of Ride Sourcing and Ride Sharing by **reducing the waiting time** which is the **function of Demand , Income of Driver and fleet size**
- Waiting time can be reduced by increase the fleet size with proportion to income to driver per day
- When Cab fleet size is small, waiting time of passenger is long.
- Excessive fleet size can attract more passengers. But the taxi driver income decreases due to high vacancy rate that further reduces the supply

Relation in App base Cab Market

PASSENEGER ⟷ (Trip Demand / Waiting Time) ⟷ MARKET ⟷ (Supply / Income) ⟷ TAXI DRIVER

GOVERNMENT → (Fleet Size / Fare) → MARKET

Upper Level Model -The upper-level model is minimizing the waiting time of passenger in peak hour and maximizing the income of the driver for one day.

$$T_W^P = \frac{\gamma}{\frac{Nh}{24} - \mu^P Q^P}, (\gamma > 0)$$

$$W = \frac{(aQ^P + bQ^O) \bullet (P + (D-3) \bullet P_z)}{N}$$

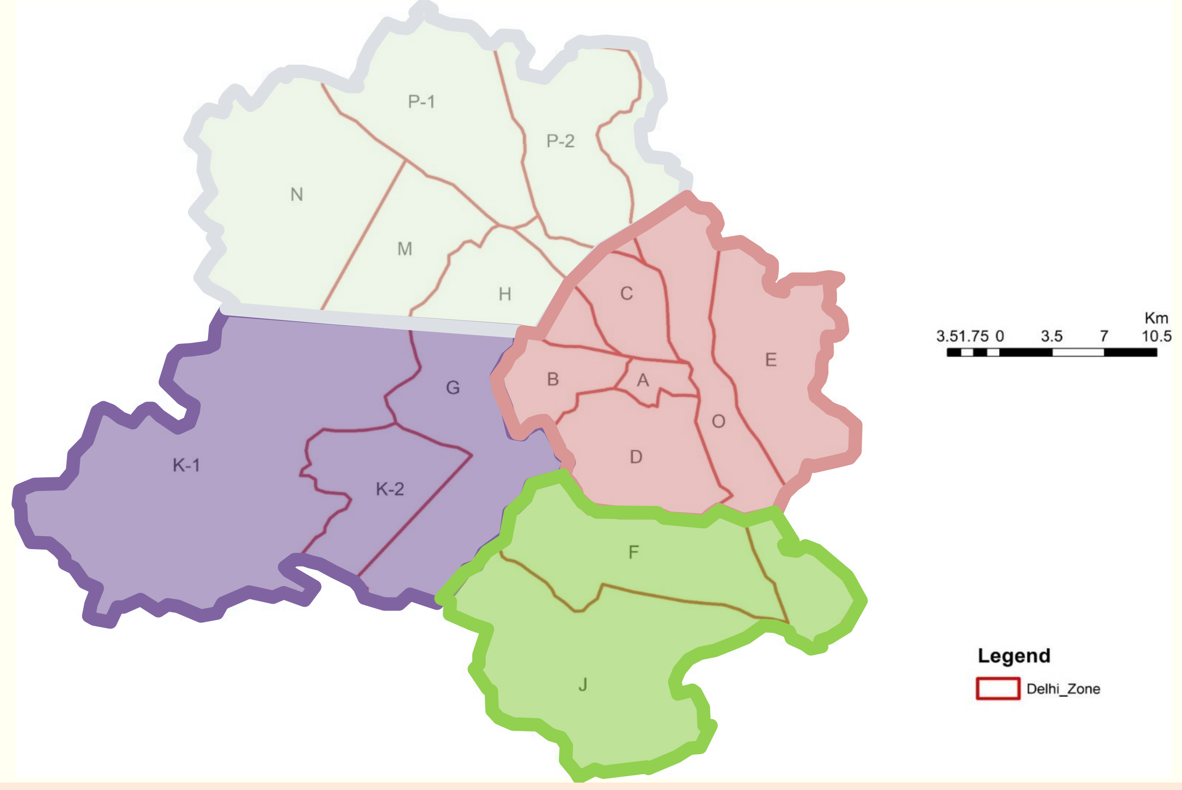
- T^P_W = The average waiting time of passenger at rush hour
- N = the taxi fleet size of a city
- h =(0<h<24) is the average operating time of a taxi per day
- μ^P = Average time of passenger taking taxi at rush hour
- γ = Positive parameter to weight the passenger waiting
- Q^o and Q^p = Demand at off-peak hour and rush hour
- D = Average distance of passenger taking taxis
- a = Hours of rush hour
- b = Hours of off-peak hour
- P = Flag- down fare
- P_z = Fare per kilometre
- W = Income of driver per day

Source :-Fleet size and fare optimization for taxi under dynamic demand China, Baozhen Yao (2016)

Outcome there is a considerable reduction in waiting from 10 min to 3min

1(b) Waiting Time Reduction by Zoning Operation Area

- **Area of Delhi NCT = 1483 km²**
- **Area of Each Zone = 370 km²**
  (Radius of Each Zone = 11 km
- **Zoning the Operation Area** of Delhi into **4 zones** and Capping them with minimum of cabs so that Waiting time can be reduced



- **4 Zone** are made with approx. **11km radius**
- Each zone will become accessible with reduction in Waiting time as Short trips are
- There will be significant reduction in **Dead mileage** also
- **Dedicated Parking Lots for Shared Mobility** should be provide in Multi-level Parking, Commercial Area and Government Buildings which are **Demand Zone** which further **reduce WAITING TIME**

Proposal 2- Reduction In Vehicle time

High Occupancy Vehicles (HOV) lane

- Provide HOVs with faster, more reliable travel than non-HOVs (primarily single occupant vehicles)
- Priority at Signals, preferential parking for HOV's
- **Inner most lane** should be made **priority lane** for Shared Mobility

Source : Author Source