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Car sharing as a solution to urban mobility problems in india

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ABSTRACT: *Urban commuters are faced with diverse problems ranging from traffic jams, parking congestions, ownership responsibilities of vehicles etc. Urban mobility is in need of means that address the contemporary problems of the commuters and provide ubiquitous accessibility. This is the reason behind the success of car aggregators in urban regions of India. Car-sharing is an alternative to personal vehicle ownership. Car-sharing refers to accessing a car for money typically with the help of an online application. Car sharing provides an experience of enjoying all the benefits of a car without ownership responsibilities. Although there are many car-sharing providers around the world but remarkably car manufacturing companies like BMW, Ford, GM and others have also launched car sharing programs. This study is restricted to the car sharing programs launched by car manufacturing companies. Though such car sharing facilities by car manufacturing companies are not yet available in India yet this study attempts to identify its preference among the urban masses. The emergence of a few car sharing providers in India has been witnessed but the operational models are usually restricted to round trips. Many car manufacturing companies are using innovative car-sharing models like peer-to-peer model and fractional model which has enhanced accessibility and convenience. Our study provides a comprehensive understanding of the perceptions towards car sharing and its features in relation to the contemporary problems faced by commuters in Delhi NCR (India). The study also provides cluster level analysis based on the problems faced by commuters in order to map them to the solutions presented by existing and innovative transportation models. The findings of the study reveal that a huge majority of the commuters feel that Car Sharing Program could be an appropriate and better solution to the mobility problems. Moreover, a majority of them (62%) tend to prefer car sharing over online ride sharing cabs (like Uber). Notably, a majority (68.6%) of the respondents who usually commute through these online app based ride sharing cabs display preference for car sharing. This provides a plausible prognosis that car sharing models have a potential to capture a sizeable portion of the market from existing car aggregators (which is in accordance with the findings of Bert et al., 2016). Future research in this area could focus on the current trends related to existing car sharing models operating in India and its future. Also, any transition with regard to the perception of ownership of vehicles can also be taken up for further research.*

Keywords: *Car sharing; Urban Mobility; Transporation problems; Car Aggregators*

INTRODUCTION

Car-sharing generally involves accessing a car owned by another person or entity in exchange for an agreed monetary payment. Car-sharing is the shared use of a vehicle fleet by members for trip-making on a per trip basis. There are usually four models of car-sharing: 1) Roundtrip 2) One-way 3)

Peer-to-peer 4) Fractional. In roundtrip car-sharing, members begin and end a trip at the same vehicle location and pay for use on the basis of time (hours), distance or both. One-way car-sharing enables members, who pay by the minute, to begin and end a trip at different locations—either throughout a free-floating zone or station-based model with specified parking locations. Peer-to-peer car-sharing functions like roundtrip car-sharing; however, the vehicle is typically owned or leased by private individuals and facilitated by a third-party operator. Finally, the fractional ownership model allows users to co-own a vehicle and share its costs and use. (Martin & Shaheen, 2016)

There has been an uncontrolled increase in the number of cars in India. According to Delhi Statistical Hand Book 2015, more than 26.29 lakh cars and jeeps plied in Delhi from April 2013 to March 2014. During the year 2014-15, 27.90 lakh cars and jeeps plied in Delhi. Car Registrations in India increased to 243147 Cars in July 2016 from 208755 Cars in June 2016. Car Registrations in India averaged 103291.12 (—India Car Sales‖, 2016). Driven by demand for utility vehicles, sales of passenger vehicles increased by 11.04% to 242,060 units in April 2016. While sales of passenger cars went up by 1.87% to 162,566 units in April 2016 and those of utility vehicles grew by 43% to 62,170 units. Sales of commercial vehicles gained pace on back of replacement demand and increased by 17.36% to 53,835 units (—Automobile Industry in India, 2016). Car Production in India increased to 246023 Units in July 2016 from 208219 Units in June of 2016 (—India Car Production‖, 2016). Indian auto manufacturers recorded a production of 23.4 million motor vehicles in financial year 2014-15, which also includes 3.22 million passenger vehicles. Domestic Motor Vehicle Sales for the period Apr 2015 to Mar 2016totalled 20.47 million units including Passenger Vehicles with 2.9 million units, Commercial Vehicles 0.69 m, Two-wheelers 16.5 m, Three-wheelers: 0.54 m (—Overview of the Indian auto industry‖, 2016). Easy finance and unrestricted registration by the transport authorities facilitates such enormous increase in vehicles every year. Consequently, this leads to increased traffic jams, air pollution, congestion or sometimes unavailability of parking spaces thus adversely affecting the commuters. A study conducted by IIT Madras states that Traffic congestion on Delhi roads causes losses of around $10 billion annually which is on account of fuel wastage due to the idling of vehicles, air pollution, loss of productivity and road crashes (Dash, 2017). Although, some attempts from the Delhi government including odd/even plan which was implemented twice posed as a solution to the problem but perhaps not a very pragmatic and lasting one.

Traditional public transport again comes with a lot of disadvantages like inconvenience, unsafe particularly for women, and often considered averse to social status at least by the upper middle class and the affluent class. Online app based cabs like Ola and Uber seem to address the problems of the commuters. Ola started its operations in India from December 2010 and has more than 200000 cars in more than 100 cities. While Uber started in India in October 2013 and now has 150000 cars operating in 18 cities. Booking cabs through smart-phone apps has more or less become a trend among tech savvy youth. The combined market share of Ola and TaxiForSure is 80%. Meru's share has dropped to 12 % while Uber is at 4%. All other taxi companies together have the rest. According to the Association of Radio Taxi India, the taxi business in the country is growing at 20% to 25% a year. The organized taxi sector accounts for just 4% to 5% of the industry and totals $800 million. It is expected to grow to $7 billion by 2020 (Das, 2015).According to a research conducted on customer satisfaction with Ola cabs out of 276 respondents majority (48%) were satisfied with Ola based on the factors like easy to book, economical, convenient, quick and safe (Manjunath,G, 2015).

Car-sharing services emerged in Europe during 1940s while in United States or other key markets they did not grow significantly until the 1990s. As of 2012, approximately 1.8 million car-sharing members were using services in 27 countries across 5 continents (Berman et al., 2013).

Car sharing provides an experience of enjoying all the benefits of a car without ownership responsibilities. Also at the same time it might be more economical than cabs. According to a BCG

Research Report 86000 car sharing vehicles were operating in 2015 with 5.8 million users booked for 2.5 billion minutes per year generating EU 650 million per year (Bert et al.,2016). Till the year 2006 car-sharing had grown to include approximately 600 cities around the world in 18 nations. A dramatic shift in car sharing business has been noticed with the fact that reputed car manufacturing companies like BMW, General Motors Co., Ford Motor Co. and Fiat Chrysler Automobiles NV are among the automobile companies still willing or already invested in car-sharing programs around the world. This has been witnessed in response to online app based cabs in order to provide a better commuting alternative. Notably these companies have used or are planning to use innovative car sharing models like peer to peer and fractional which seem to be more advantageous to the users than the traditional models.

Car-sharing is an alternative to personal vehicle ownership which grants drivers convenient and affordable access to a range of vehicles on an hourly or daily basis. It enables the users to avail mobility without the expense and hassle associated with owning a car. Membership in a car-sharing program usually requires an annual and/or initiation fee, and the vehicles carry hourly or daily rental costs. Urban congestion also leads to an increase in the cost of owning a private vehicle by city residents (Berman et al., 2013).

Car-sharing attracts new members by presenting a less expensive option than private car ownership in that a driver only pays for vehicle use as needed, does not need to pay for or worry about parking, and may be somewhat protected from rising operating costs – although car-sharing rates will take actual operating costs into account. The trend away from individual car ownership is also related to the global economic downturn that began in 2008. In challenging economic conditions, lesser number of people, particularly younger people, are able to afford owning and maintaining a car, and that is a contributing factor to the shift towards car sharing (Berman et al., 2013).

Business models have evolved to include both point-to-point and round-trip systems, while parking options have expanded to include both on-street and dedicated spaces in an increasing number of new developments, increasing the flexibility and convenience of car-sharing. Car2go is considered as the largest car-sharing operator in the world, with a presence in nine countries and nearly 30 cities.

Following are the objectives of the study:

1. To study the problems being faced by commuters in Delhi NCR and clustering the commuters on the basis of such problems.
2. To study the customer perception with regard to owning a car.
3. To study the commuters' preference for car sharing program associated with car manufacturing companies if launched in India.

1. LITERATURE REVIEW

Shaheen et al. (1998) reviewed the car sharing experience, its future prospects, services provided and use of advanced communication and reservation technologies. It was concluded that Car sharing organizations are more likely to be economically successful when they provide a dense network and variety of vehicles, serve a diverse mix of users, create joint marketing partnerships, design a flexible and simple rate system and offer easy emergency access to taxis and long-term car rentals. They are more likely to prosper when environmental consciousness is high, driving problems like high parking costs and traffic congestion are prevalent, car ownership costs are high and alternative modes of transportation are easily accessible. It was also found that car sharing enhances mobility and accessibility particularly for less affluent people.

Dr Scott le Vine et al. (2014) conducted a study on evolution, challenges and opportunities of car sharing. It was found that users of round-trip car-sharing services tend to be well educated, predominantly males, young adults, predominantly between ages 25 and 45 years, living as singles or

childless couple households, living in middle or middle/upper income households, living in carless or single-car households, living in urban neighbourhoods, relatively heavy users of non-car forms of urban transport (like public transport, walking and cycling).

Dill et al. (2014) conducted a major research in Portland, Oregon in which early results reveal that people who list their cars for rent through a peer-to-peer service are relatively young, well-educated, and in moderate/upper income households. A majority of the respondents (58%) indicated that the car they make available for rent through the service is the only car their household owns.

Martin and Shaheen (2010) studied the impact of car sharing on car ownership. It was found that car-sharing can substantially reduce the number of vehicles owned by member households, despite the fact that 60% of all households joining car-sharing are carless. It was found that car-share households displayed a dramatic shift towards a carless lifestyle. It was estimated that every car-sharing vehicle removes between 9 and 13 other vehicles from the road.

Gao et al. (2014) studied the transformation in the automobile industry. It was found that millennials (18–34 years old) appear to consider car ownership less important as compared to previous generations. They are more open to sharing cars and to the rapidly growing number of ‒mobility services,‖ such as Uber and Lyft. But still, increased car sharing does not necessitate a fallin car sales.

Bert et al. (2016) conducted an analysis of car-sharing and its impact on vehicle sales. It was found that Car sharing will reduce vehicle sales by approximately 550,000 units by 2021 and cause net revenue loss to OEMs of EURO 7.4 billion. By 2021, 35 million users will book 1.5 billion minutes of driving per month and generate annual sales of EU 4.7 billion. 86000 car sharing vehicles were operating in 2015 with 5.8 million users booked for 2.5 billion minutes per year generating EU 650 million per year. It will become increasingly relevant to a cohort of mostly youngster drivers. Automotive Vehicles are considered to be the real game changers rather than Car-sharing. But as they are going to be launched by 2027, car sharing has ample time to evolve and grow. Ride Sharing apps like Uber and Lyft pose a serious threat to car sharing because both target the same set of users. But price conscious people may opt for car sharing as it is cheaper.

Berman et al. (2013) conducted a global market analysis of car sharing programs. It was observed that the perception of owning a private automobile as a means of status and freedom has started to change, most significantly among people of the age of 35 years and younger and has been replaced by a new characteristic of collaborative consumption, where access rather than ownership has become more important. This new generation of consumers wants the ease and convenience of using a product but is willing to give up a small benefit of flexibility in exchange for shedding the burden of complete ownership. The research projects that global car-sharing services revenue will grow to $6.2 billion by the year 2020 at a CAGR of 30.9%. North America and Europe are estimated to retain their leading positions as the two largest car-sharing markets because they have the necessary conditions to spur growth in car-sharing, including the presence of large and growing urban areas, high personal transportation costs, and adequate public transit in many urban areas. The potential for expansion in Asia Pacific is more restricted due to the less number of countries with the right characteristics for car-sharing but the region will have a higher CAGR than North America and Europe because it got a slower start in the car-sharing market and is going through a major expansion.

Viechnicki et al. (2015) conducted a study on modern mobility options and their impact. It was found that New York City metro area could reduce its vehicle population by almost 3% if car-sharing were fully implemented, and could potentially see car-sharing membership as high as 13.2% of all commuters. It is projected the potential annual savings from car-sharing to reach a ceiling of $4.3 billion annually. These savings would come from different sources. Car-sharing would enable its

driver members to save $1.4 billion in direct vehicle maintenance and upkeep costs as they reduce their own driving. Commuters would benefit from reduced congestion, avoiding $185 million worth of wasted fuel and $2.2 billion in time delay. Also, cities would save $366 million annually in deferred road construction costs, $77 million in accident avoidance, and $36 million in savings from almost 1 million metric tons of reduced carbon dioxide emissions.

Baptista et al. (2015) conducted a study on the impact of implementing car sharing programs worldwide. It was concluded that car sharing fills a mobility gap in sustainable transport. A sensitivity analysis of the economic model was performed which revealed that the variables having higher influence were cost-related variables (reducing the break-even timeframe from 36% to 57%), such as vehicle purchase cost, insurance, maintenance and tax costs, and fuel cost. It is also possible to assert that shifting from private vehicle to car sharing will have favourable impacts on the environmental contribution of the transport sector, by reducing carbon dioxide emissions.

Martin and Shaheen (2016) conducted a research study on impacts of car-sharing platform car2go with respect to five north American cities namely Calgary, San Diego, Seattle, Vancouver, and Washington, D.C. The results of the study indicate that car2go is substituting for taxis among the majority of respondents in most cities. For driving, the results are more nuanced. in most cities, the change in intercity rail due to car2go was very small. A majority of members use public transit less frequently; walk more frequently; use taxis less frequently; and have a range of impacts on other modes. The vast majority of respondents indicated that car2go did not result in a vehicle sale or a postponed purchase. Overall, car2go has a net vehicle reduction despite the fact that only a minority of the sample indicated a causal effect on vehicle holdings.it is likely that the suppression effect (in contrast to vehicles sold) will increasingly dominate the impacts found within large-scale studies on the impacts of car-sharing and other shared modes in core urban areas. broader population does not appear to drive car2go for large distances.one-way car-sharing is almost certainly reducing overall vehicle miles travelled.

Schmoller and Bogenberger (2013) investigated the factors responsible for influencing the demand for car-sharing with reference to Munich city. Car-sharing is mostly used by university students. Areas with high young population witness more bookings. Weather has no significant impact. Age structure of a city has significant impact on success of free floating car-sharing.

Shaheen & Stocker (2015) conducted an online survey on corporate members of car sharing organization -Zipcar. The results reveal that 20% of the corporate members surveyed (total 523) reported to have sold their vehicles while another 20% reported to have postponed their purchase of vehicles. Majority (37%) of the respondents report that in case zipcar was unavailable they would resort to traditional car rentals.

Bardhi and Eckhardt (2012) conducted an interpretive study of zip car consumers to examine access based consumption with regard to car sharing and outcomes of access-based consumption. It was found that consumers do not experience perceived ownership and avoid identification with the accessed object of consumption. Motivations for engaging in car sharing are primarily utilitarian as compared to identity enhancing, and there is also a preference for surveillance and command controls rather than relying on trust and community. The findings also emphasize that though access has gained popularity but still ownership continues to remain the ideal normative mode of consumption in contemporary American society.

Katzev (2003) conducted a study on the concept of car-sharing as a solution to the transportation problems faced by urban commuters. The research was centered on the early adopters of Car Sharing Portland which is the first commercial car-sharing organization in the USA. The main causes of motivation for adopting car-sharing were identified as occasional need for a vehicle and financial

savings. It was found that 26% of the car-sharing members sold their personal vehicles and 53% of them were able to avoid an intended purchase. Also, a majority of members were reported to have increased the use of public transit, cycling and walking.

Alfian et al. (2015) conducted a research on one-way car sharing and its performance evaluation by way of a simulation model. The findings reveal that total number of reservations, number of cars, distribution of one-way reservation and total number of lots at each station are going to affect the utilization and acceptance ratio. As the number of customers increase, the reservation based one-way service is better as compared to instant access one-way due to its impact on high profit and high customer satisfaction.

Loose et al. (2006) assessed the means of promoting car sharing in Germany. It was recommended that car sharing organizations should focus on customer orientation, publicity, target group alignment, meeting the needs and finding a balance between private and business car sharing demands and modernization of technical application.

Rabbitt and Gosh (2013) evaluated the market potential of car sharing taking into consideration geographic, financial and environmental factors. It was found that car owners traveling mostly on alternative modes, could make significant cost and Carbon dioxide reduction through car sharing. An annual reduction of carbon dioxide emissions of 86 kt is found to be achievable through car sharing, with possible reductions up to 895 kt with the help of apt policy and financial support.

Schaefers et al. (2016) studied the transition in the perception of consumers from ownership to access based services. It was found that access based services enable consumers to avoid the burdens of ownership which include risks and responsibilities that come along with owning a good. The findings reveal that access based service usage is positively influenced by all three ownership risk perceptions i.e. financial, performance and social. Moreover, increased usage of an access based service by consumers increases the likelihood of reduced ownership.

Jayaraman et al. (2016) studied the environmental concerns among people in Malaysia which act as a driver towards using free bus services. Part of the findings reveal that people are beginning to take note of the environmental problems and the ultimate benefits of using public transport for primary travel to address issues of traffic congestion.

Khandelwal et al. (2016) conducted a study on the purchase factors for hybrid cars in India. It was found that seeking information about green product, its social value and social value of hybrid cars is positively associated with the intention of purchasing hybrid cars among Indian consumers. Indian consumers seem not ready for the idea of purchasing eco-friendly cars i.e. hybrid cars, and it would take a long time to spread sufficient awareness with regard to benefits of hybrid cars among Indian consumers.

2. RESEARCH METHODOLOGY

A descriptive research was conducted to identify the problems faced by the commuters in Delhi NCR region of India. The study focused on the preference for car sharing programs by automobile companies if launched in India. The research also examined transition in the perception of ownership of cars in Delhi NCR. For the purpose of the research both primary and secondary data sources were considered. Primary data has been collected by way of questionnaire method. Secondary data for the research has been collected from relevant research papers and research articles published in various journals and online resources.

Convenience sampling technique was used to collect the primary data necessary for the study. The sample size consisted of 680 respondents.

The respondents predominantly consisted of students aged between 20-30 years residing in Delhi NCR. The respondents were mostly from the annual income group of Rs.5,00,000 to Rs.8,00,000. The respondents consisted of 55.4% males and 44.6% females.

The questionnaire was aimed at collecting necessary information about the problems faced by commuters, understanding current trends in mobility and it focused on gathering perceptions of the respondents concerning the car sharing program which could be a plausible remedy and apt alternative to currently available means of transportation. The respondents were informed beforehand about the concept of car sharing so as to get proper responses.

3. DATA ANALYSIS

3.1 Demographic Profiling

Table-1: Demographics of the Respondents

Age	**Frequency**	**Percent**
Below 20 Years	78	11.5
20-30 Years	502	73.8
30-40 Years	39	5.7
40-50 Years	32	4.7
Above 50 Years	29	4.3
Total	**680**	**100.0**
Gender	**Frequency**	**Percent**
Male	377	55.4
Female	303	44.6
Total	**680**	**100.0**
Profession	**Frequency**	**Percent**
Student	378	55.6
Self Employed	95	14.0
Employed in Public Sector	26	3.8
Employed in Private Sector	149	21.9
Unemployed	32	4.7
Total	**680**	**100.0**
Annual Household Income	**Frequency**	**Percent**
Less than Rs. 5,00,000	173	25.4
5,00,000 • 8,00,000	181	26.6
8,00,000 • 11,00,000	118	17.4
11,00,000 • 14,00,000	71	10.4
Over Rs. 14,00,000	137	20.1
Total	**680**	**100.0**

Most of the respondents (73.8%) belong to the age group of 20-30 years (see Table-1). 55.4% of the respondents are males while 44.6% of the respondents are females. Students comprise the most of

the percentage of respondents (55.6%) followed by private sector employees (21.9%). Most of the respondents (26.6%) are from the income group Rs.5,00,000 to Rs.8,00,000.

3.2 Mode of Commuting

Most of the respondents commute (see Table-2) by their own cars (49.6%) followed by Metro (19.4%). Least number of respondents travel through auto-rickshaws (3.8%) and buses (4.3%).

Table-2: Mode of Commuting

Mode of Commuting	Frequency	Percent
Own car	337	49.6
Metro	132	19.4
Traditional taxi/cab	34	5.0
Online cab like Ola/Uber	86	12.6
Auto rickshaw	26	3.8
Bus	29	4.3
Other	36	5.3
Total	680	100.0

3.3 Intensity of the problems faced by the commuters

Traffic Jams (see table-3) are considered to be the most serious problem (with mean ratings as 3.78) by the respondents while traveling through their own cars followed by air pollution (3.46). While as ownership responsibilities are considered as the least significant problem. The most intense problem faced while using public transport like metro, auto-rickshaw and buses is considered to be time consumption (mean of 3.01) followed by Inconvenience (2.80).

Table-3: Intensity of the problems faced by the commuters

Problems Faced -Own Car	**Mean Ratings**	**Problems Faced- Public Transport**	**Mean Ratings**
Traffic Jams	3.78	Affects Social status	2.05
Ownership Responsibilities	2.85	Inconvenience	2.80
Unavailability of parking space	3.38	Time Consuming	3.01
Fuel and Maintenance costs	3.10	Unsafe	2.70
Increased Air Pollution	3.46		

3.4 Impact of Aggregators on Ownership of Cars

It has been found that a majority (66.3%) of the respondents don't feel that car aggregators could have an impact on their ownership of cars (see table-4).

Table-4: Impact of Car Aggregators on ownership cars

	Frequency	Percent
Yes	229	33.7
No	451	66.3
Total	680	100.0

Also, a huge majority (72.5%) of the respondents who feel that it would have an impact feel so with regarding lesser use of the owned car. While only 7.9% of the respondents opted for selling off at least one car (see table-5).

Table-5: Manner of Impact on ownership of cars

	Frequency	Percent
Less use of your car	166	72.5
Won't purchase more cars	41	17.9
Sell off at least one of your cars	18	7.9
Other	4	1.7
Total	229	100.0

3.5 Preference for Car Sharing

Table-6: Car Sharing as a better solution to the problems

	Frequency	Percent
Yes	580	85.3
No	100	14.7
Total	680	100.0

A huge majority of the respondents (85.3%) consider car-sharing to be a better solution to the problems faced by the commuters (see table-6).

Table-7: A comparison between demographics and preference for car sharing

		Would you prefer car sharing facility offered by car manufacturing companies (like Ford and BMW) over online app based cabs like Ola and Uber?		Total
		Yes	No	
Gender	Male	252	125	377
	Female	170	133	303
Total		422	258	680

Annual Household Income	Less than Rs. 5,00,000	102	71	173
	5,00,000 • 8,00,000	128	53	181
	8,00,000 • 11,00,000	73	45	118
	11,00,000 • 14,00,000	49	22	71
	Over Rs. 14,00,000	70	67	137
Total		422	258	680
Age	Below 20	36	42	78
	20-30	332	170	502
	30-40	19	20	39
	40-50	16	16	32
	Above 50	19	10	29
Total		422	258	680
Profession	Student	230	148	378
	Self Employed	51	44	95
	Employed in Public Sector	21	5	26
	Employed in Private Sector	105	44	149
	Unemployed	15	17	32
Total		422	258	680
Mode of Commuting	Own car	209	128	337
	Metro	78	54	132
	Traditional taxi/cab	20	14	34
	Online cab like Ola/Uber	59	27	86
	Auto rickshaw	16	10	26
	Bus	17	12	29
	Other	23	13	36
Total		422	258	680

Most of the respondents (62%) would prefer car sharing over online app based cabs of which 59.7% are males. 66.84% males, while only 56.1% females, prefer car sharing. 70.72% of the respondents from the household income group Rs.5,00,000 to Rs.8,00,000 and 69.01% of respondents belonging to the income group of Rs.11,00,000 to Rs.14,00,000 prefer car sharing over online taxi apps. While only 51.09% of the respondents from the income group of Rs.11,00,000 to Rs.14,00,000 prefer car sharing.66.14% and 65.52% of the respondents from the age group 20-30 years and above 50 years respectively prefer car sharing over online taxi services while only 46.15% and 48.72% from the age group of below 20 years and 30-40 years respectively prefer car sharing.60.85% of the respondents who are students, 80.77% and 70.47% of the respondents who are public sector and private sector employees respectively prefer car sharing. While only 46.88% of the respondents who are

unemployed prefer car sharing.68.60% and 62.02% of the respondents who commute by online cabs and own cars respectively tend to prefer car sharing.

3.6 Chi-square Tests

Hypothesis:
H_0: There is no significant relationship between the given factors and preference for car sharing.
H_a: There is a significant relationship between the given factors and preference for car sharing.

Table-8: Pearson Chi-Square Tests between factors and preference for Car Sharing

Factors	Value	Df	Asymp. Sig. (2-sided)
Gender	8.226	1	.004
Annual Household Income	14.925	4	.005
Age	16.995	4	.002
Profession	14.541	4	.006
Means of Commuting	2.410	6	.878

H_0 is rejected in case of Gender, Annual Household Income, Age and Profession as the corresponding p-values are less than 0.05. So, there is a significant impact of these factors on preference for car sharing. While as for means of commuting H_0 is not rejected i.e. there is no a significant impact of means of commuting on preference for car sharing.

3.7 ANOVA Tests

Hypothesis:
H_0: Groups based on demographics and mode of commuting rate various features of car sharing evenly.
H_a: There is a significant difference in the means of at least one group

Table-9: ANOVA Table based on Ratings of Various Features of Car Sharing

	Age			Income			Gender			Profession			Mode of Commutation		
Factors	SD	F	Sig.	SD	F	Sig.	SD	F	Sig.	SD	F	Sig.	SD	F	Sig.
Economical Running Expenses	1.183	1.775	.133	1.183	2.910	.021	1.183	.075	.784	1.183	.640	.634	1.183	2.040	.059
Convenience	1.106	1.177	.320	1.106	2.486	.043	1.106	.386	.535	1.106	.812	.518	1.106	2.019	.062
Environment friendly	1.146	1.649	.161	1.146	1.913	.107	1.146	.386	.534	1.146	1.24	.293	1.146	.826	.550

Free from Ownership Responsibilities	1.151	.240	.916	1.151	.838	.501	1.151	.102	.750	1.151	.495	.739	1.151	2.127	.049
Reduced Traffic Jams & Parking Congestions	1.185	1.186	.316	1.185	2.072	.084	1.185	.023	.881	1.185	.979	.419	1.185	2.405	.027
Free to choose your car every time	1.242	.615	.652	1.242	1.030	.391	1.242	.977	.324	1.242	.546	.702	1.242	2.145	.047

In case of age groups, gender and profession, H_0 is not rejected as the p-values are greater than 0.05. So, there is no significant difference in the means of ratings of car sharing features based on age groups, gender and profession. In case of income groups, there is a significant difference in the means of Economical running expenses and convenience factors while there is no significant difference in the means of other factors based on income groups. In case of mode of commutation, factors like ownership responsibilities, reduced traffic jams & parking congestion and free to choose the car every time displays significant difference in the means of the groups of different modes of commuting.

3.8 Cluster Analysis

The respondents were grouped into clusters on the basis of the problems faced by them during commuting. For the purpose of this analysis data based on 1-5 Likert scale was considered which enabled the respondents to rate the intensity of the problems faced.
Cluster analysis was conducted in two stages:

Stage 1: First of all, in order to find out the number of clusters in the existing data a hierarchical cluster analysis has been conducted using Ward's method.

Table-10: Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	666	667	.000	0	0	145
2	636	637	.000	0	0	425
3	633	634	.000	0	0	56
4	602	603	.000	0	0	545
…	…	…	…	…	…	…
673	2	9	3598.100	671	668	675
674	5	18	3740.389	605	662	676
675	2	19	3886.472	673	665	677
676	1	5	4187.371	667	674	677
677	1	2	4618.896	676	675	679
678	4	7	5221.402	672	669	679
679	1	4	6111.000	677	678	0

The agglomeration schedule (see table-10) shows a drastic change in the coefficients at stage 676 indicating a 4-cluster solution.

Table-11: Number of Clusters and their size

Clusters	Frequency	Percent
1	208	30.6
2	248	36.5
3	129	19.0
4	95	14.0
Total	680	100.0

Table-11 shows the size of the four clusters formed and their respective percentage

Stage 2: After identifying the number of clusters, K-means clustering technique was used. The final cluster centres obtained thereby exhibits the mean value for every variable of each cluster on the basis of which the clusters have been interpreted.

Table-12: Final Cluster Centres

	Cluster			
	1	2	3	4
While commuting by personal car - Traffic Jams	4	2	4	4
While commuting by personal car - Ownership Responsibilities	4	2	2	3
While commuting by personal car - Unavailability of parking space	4	2	3	4
While commuting by personal car –Fuel and Maintenance costs	4	2	2	4
While commuting by personal car - Increased Air Pollution	4	2	3	4
While commuting by public transport - Affects Social status	3	1	2	1
While commuting by public transport - Inconvenience	4	2	4	2
While commuting by public transport - Time Consuming	4	2	4	2
While commuting by public transport –Unsafe	4	2	3	2

The above table-12 which indicates final cluster centres with average scores of each cluster against problems faced can be elucidated with the help of the following interpretation schedule.

Table-13: Interpretation Schedule

Mode of Commuting	**Problems**	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**
Personal Car	Traffic Jam	Very Intense	Less Intense	Very Intense	Very Intense
	Ownership Responsibilities	Very Intense	Less Intense	Less Intense	Moderately Intense
	Unavailability of parking space	Very Intense	Less Intense	Moderately Intense	Very Intense
	Fuel and Maintenance costs	Very Intense	Less Intense	Less Intense	Very Intense
	Environmental Pollution	Very Intense	Less Intense	Moderately Intense	Very Intense

Public Transport	Affects Social Status	Moderately Intense	Least Intense	Less Intense	Least Intense
	Inconvenience	Very Intense	Less Intense	Very Intense	Less Intense
	Time Consuming	Very Intense	Less Intense	Very Intense	Less Intense
	Unsafe	Very Intense	Less Intense	Moderately Intense	Less Intense

The four clusters so framed can be interpreted with the help of the interpretation schedule (see Table-13). Cluster-1 represents respondents who rate all the problems as very intense (average rating of 4 on a scale of 5) except moderate impact (average rating of 3) on negative social status by travelling through public transport. Members belonging to Cluster-2 on the other hand seem to be unaffected by the problems of transportation as they consider all the problems as less intense (average of 2). Cluster-3 consists of respondents who consider traffic jams while travelling through personal cars and inconvenience and time consuming nature of public transport to be very intense (average of 4). Members of Cluster-4 tend to be very intensely affected (average rating of 4) by the problems specific to commuting by personal car including Traffic Jams, Unavailability of parking space, Fuel and Maintenance costs and Environmental Pollution.

Table-14: ANOVA Comparing Rating for Car Sharing factors based on Clusters

		Sum of Squares	df	Mean Square	F	Sig.
Economical Running Expenses	Between Groups	47.073	3	15.691	12.093	.000
	Within Groups	544.962	420	1.298		
	Total	592.035	423			
Convenience	Between Groups	43.541	3	14.514	12.853	.000
	Within Groups	475.409	421	1.129		
	Total	518.951	424			
Environment friendly	Between Groups	55.418	3	18.473	15.524	.000
	Within Groups	500.972	421	1.190		
	Total	556.391	424			
Free from Ownership Responsibilities	Between Groups	68.759	3	22.920	19.556	.000
	Within Groups	493.420	421	1.172		
	Total	562.179	424			
Reduced Traffic Jams & Parking Congestions	Between Groups	64.641	3	21.547	17.096	.000
	Within Groups	530.597	421	1.260		
	Total	595.238	424			
Free to choose your car every time	Between Groups	69.088	3	23.029	16.570	.000
	Within Groups	585.109	421	1.390		
	Total	654.198	424			

The above ANOVA table presents a comparison of means of the ratings for car sharing factors among the above framed clusters based on problems faced by commuters. It is observed that there is a significant difference in the means of at least one cluster with respect to all of the factors for opting car sharing. It is imperative that the clusters exhibit differences in their preference towards various features of car sharing.

Table-15: Crosstab between Clusters and Factors for opting for Car Sharing

Factors		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Economical	Least Preferable	5	7	3	15	30
	Slightly Preferable	16	23	15	17	71
	Preferable	42	54	27	9	132
	Highly Preferable	39	41	18	6	104
	MostPreferable	40	18	20	9	87
Total		142	143	83	56	424
Convenience	Least Preferable	3	3	1	4	11
	Slightly Preferable	11	22	15	24	72
	Preferable	30	49	23	12	114
	Highly Preferable	50	46	25	5	126
	MostPreferable	49	23	19	11	102
Total		143	143	83	56	425
Environment friendly	Least Preferable	5	4	3	12	24
	Slightly Preferable	11	21	15	21	68
	Preferable	39	66	19	8	132
	Highly Preferable	47	35	26	6	114
	MostPreferable	41	17	20	9	87
Total		143	143	83	56	425
Free from Ownership Responsibilities	Least Preferable	0	6	4	12	22
	Slightly Preferable	8	23	12	20	63
	Preferable	37	41	26	10	114
	Highly Preferable	54	46	23	4	127
	MostPreferable	44	27	18	10	99
Total		143	143	83	56	425
Reduced Traffic Jams & Parking Congestions	Least Preferable	7	7	6	13	33
	Slightly Preferable	20	27	10	21	78
	Preferable	37	55	24	14	130
	Highly Preferable	38	39	25	4	106
	MostPreferable	41	15	18	4	78
Total		143	143	83	56	425
Free to choose your car every time	Least Preferable	1	6	7	10	24
	Slightly Preferable	12	24	13	17	66
	Preferable	25	33	19	13	90
	Highly Preferable	38	46	17	4	105
	MostPreferable	67	34	27	12	140
Total		143	143	83	56	425

The above Table-15 depicts that the majority of the members belonging to cluster-1 rate the factors Reduced Traffic Jams & Parking Congestions and Free to choose the car every time as most

preferred for car sharing. Majority of the members of Cluster-2 rate the factors Free from Ownership Responsibilities and Free to choose the car every time as highly preferable. Majority of the members of Cluster-3 rate _Free to choose the car every time' as most preferable. While as, majority of the members of Cluster 4 rate all the factors as slightly preferable (2 on a scale of 5).

4. CONCLUSIONS AND RECOMMENDATIONS

The study entailed an understanding of the contemporary problems faced by the commuters. It could be deciphered from the results that Traffic Jam is considered to be the most intense problem by the commuters while traveling through their own cars followed by environmental pollution. While as ownership responsibilities are considered as the least significant problem. The findings also show that the most intense problem faced by commuters while using public transport like metro, auto-rickshaw and buses is considered to be huge time consumption and inconvenience while travelling. So, it is imperative that innovative mobility service providers must take into consideration these drawbacks so as to address these issues of the masses.

The findings of the study reveal that a huge majority of the commuters feel that Car Sharing Program could be an appropriate and better solution to the problems faced by the commuters. Moreover, a majority of them (62%) tend to prefer car sharing over online cabs like Ola and Uber. Notably, 68.60% of the respondents who usually commute through these online based cabs display preference for car sharing. This provides a plausible prognosis that car sharing could take away a sizeable portion of the market from these car aggregators (Bert et al., 2016). It is quite possible that the key driver for such a perception could be the brand associated with car sharing like BMW, Ford, GM etc. Although majority of the respondents (66.3%) don't turn away from the perception of ownership of cars, yet 33.7% of the respondents feel otherwise and of which a huge majority (72.5%) feel that they would resort to lesser use of their owned cars. While only 7.9% of them have decided to sell off at least one of their cars. So, it can be deduced that the car aggregators like Ola and Uber have at least been successful in affecting some of the car owners with lesser use of their vehicles. A possible growth in such trend over the years could translate into more business for cabs and consequently more opportunities for car sharing companies as well.

The results show that demographic factors like gender, annual household income and age have a significant impact on preference for car sharing. While profession and current means of commuting have no significant impact on preference for car sharing. People who opt for car sharing and prefer it over existing aggregators were found to be predominantly males, of age group 20-30 years, public sector employees, with annual household income of Rs.5,00,000 to Rs.8,00,000. On the contrary, the results show that people who are comparatively less likely to opt for car sharing include those with annual household income of over Rs.14,00,000, below 20 years of age and unemployed.

It was found that clusters which were framed on the basis of problems faced while commuting, have a significant impact on the ratings of factors for car sharing. Cluster 1 which represents people who consider most of the problems faced while commuting to be very intense, consider the factors Reduced Traffic Jams & Parking Congestions and Free to choose the car every time as most preferred feature of car sharing. Cluster 2 which consists of respondents who seem to be more or less unaffected by all of the problems generally faced while travelling, considerFree from Ownership Responsibilities and Free to choose the car every time as highly preferable. Cluster 3 which depicts people who find only traffic jams to be the major cause for concern, consider the free choice of carsfor car sharing as most preferable factor. Cluster 4 which consists of commuters who are mostly affected by problems associated with personal car like traffic jams, ownership responsibilities, fuel and maintenance and pollution, consider show comparatively little inclination towards features of car sharing. Such analysis could be prolific for the customer segmentation on the basis of their needs and

to satiate them appropriately with car-sharing services. This could be done by providing car-sharing services with an emphasis on such features which are not only apposite to the problems of the commuters but also fill the void that they feel in the current scenario in urban mobility.

It could be pointed out that a limitation of this study is that the primary data for the research was collected from the respondents of which 73.8% were between the age of 20-30 years which may not appropriately represent the perceptions of the masses in Delhi NCR.

Future research could focus on the current trend related to ownership of vehicles and any transition in the perception thereof over the years, existing car sharing models operating in India and its future. Such a research would not only elucidate the way forward for car sharing models of car manufacturing companies but also of other companies.

5. ACKNOWLEDGMENTS

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