

Assessment of Passenger Satisfaction with Public Bus Transport Services: A Case Study of Lucknow City (India)

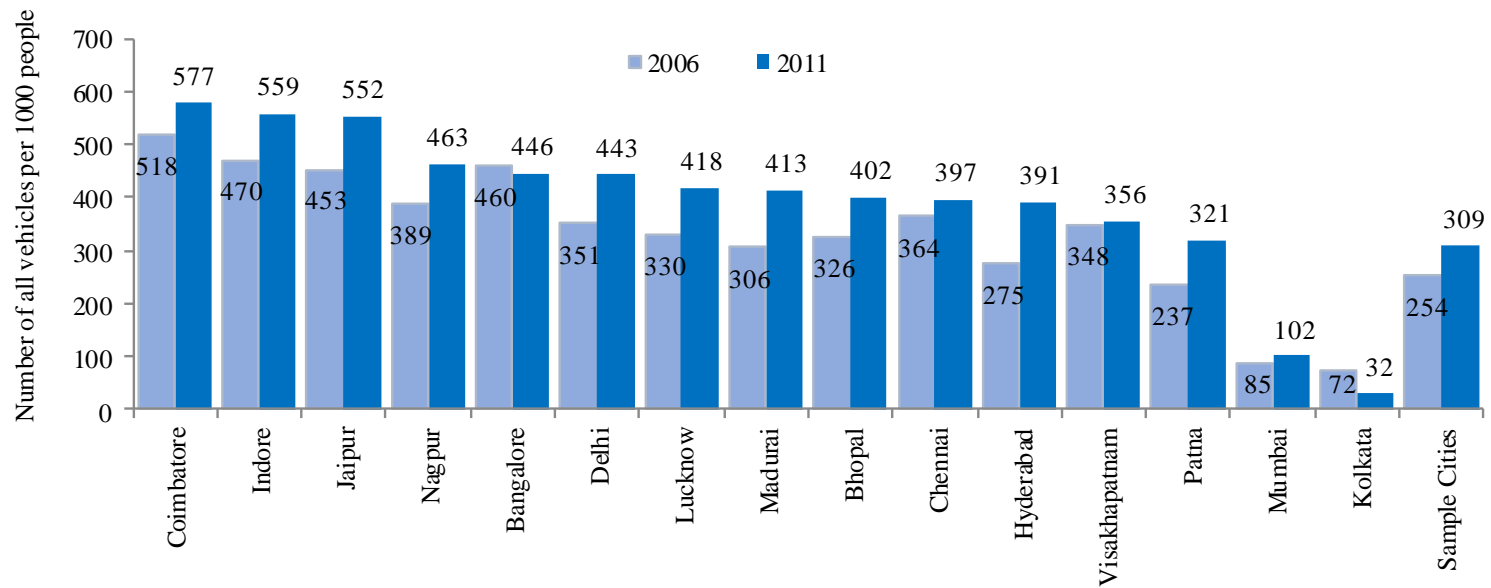
Prof. Sanjay Kumar Singh
Indian Institute of Management Lucknow

Lucknow City

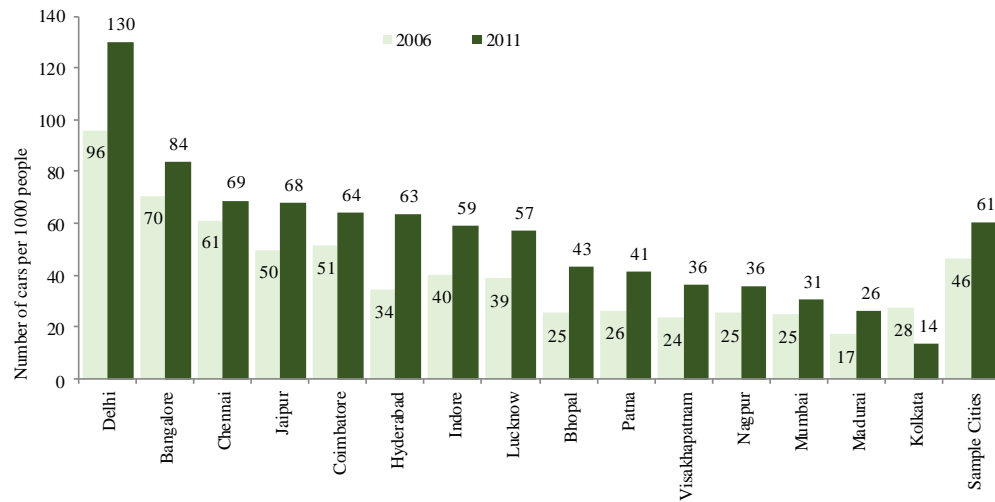
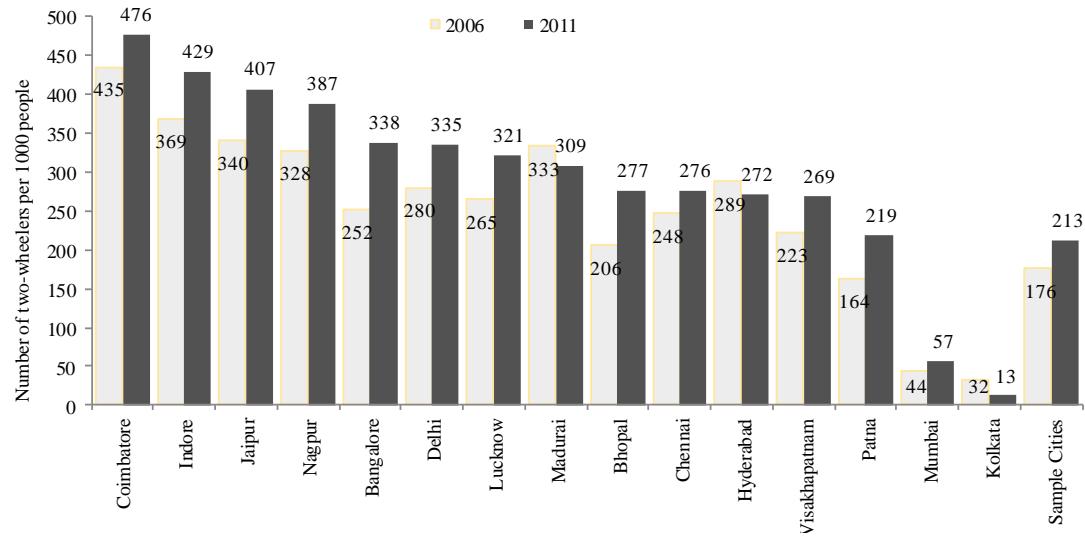
- Population: 2.25 million in 2001 to 2.81 million in 2011
- 11th most populous city of India and among the fastest growing ones
- As is the case in most of the Indian cities, transport demand in Lucknow has increased substantially over the years
- Unfortunately, public transport systems have not been able to keep pace with the rapid and substantial increase in travel demand
- Qualitatively, the available public transport services are overcrowded particularly during peak hours and involve long waiting periods
- As a result, there is a massive shift towards personalized transport, specially cars and two-wheelers, and also proliferation of various types of intermediate public transport modes, such as auto-rickshaws and taxis
- Presently, two-wheelers and cars together constitute 93% of the total vehicles in Lucknow whereas buses constitute only 0.3%

Lucknow City...

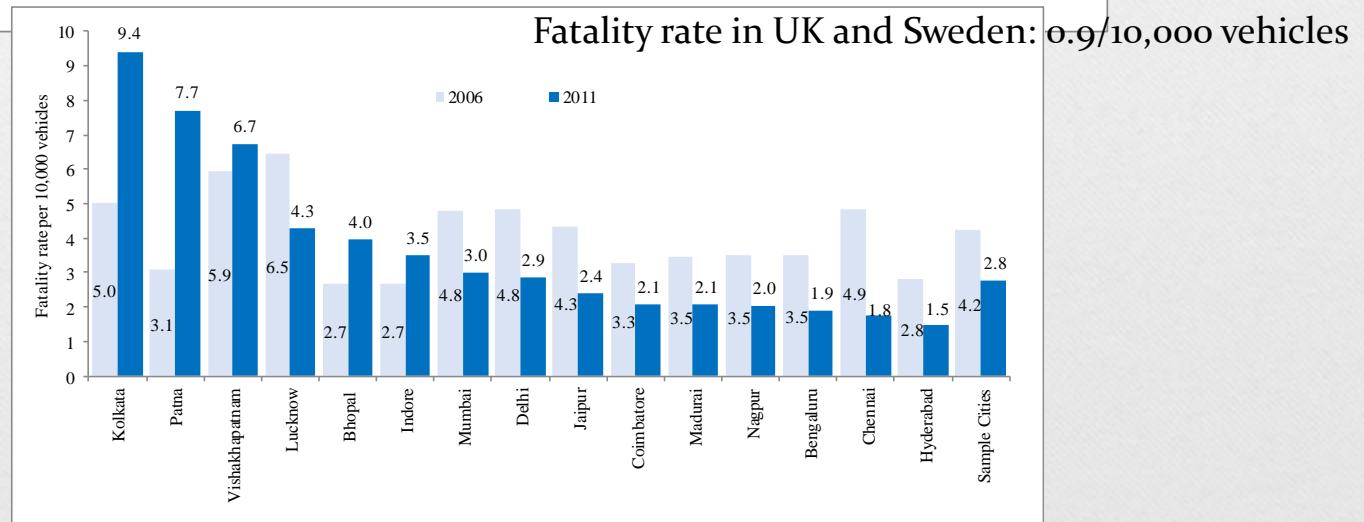
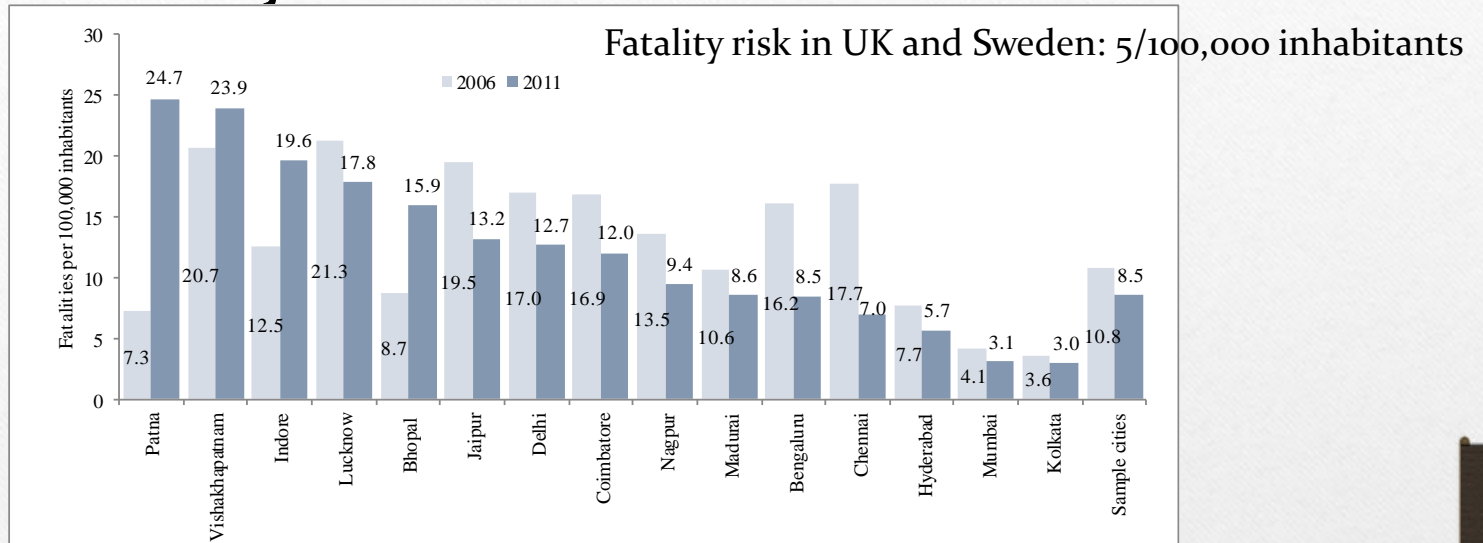
- Vehicular population growth: **10.1% per year** during last five years (TW 8.8% and Cars 13.6%)
- **Vehicle ownership rate** (per 1000 people) in 2011: 418, 321 (TW), 57 (Car) [India in 2011: 117, 84 (TW), 16 (Car); India in 2016: 174, 126 (TW), 24 (Car)]
- Estimated **vehicle ownership rate** in 2016: 530, 388 (TW), 83 (Car)



Lucknow City...



Lucknow City...



Lucknow City...

- Although higher level of motorization brings higher level of mobility particularly to the middle- and high-income segments of urban population, but its adverse impact in the form of **congestion, air pollution, and traffic accidents** is also substantial
- Growing traffic and limited road space have reduced **peak-hour vehicle speed close to 10 Km/h** in the central areas of Lucknow. The ambient air pollution in terms of suspended particulate matters in Lucknow exceeds the limit set by world health organization
- City also faces relatively high burden of road traffic accidents in comparison to its counterparts. **Road traffic fatality risk**, number of fatalities per 100,000 people, **in Lucknow (17.7) was 50% higher than that in the whole country (11.2)** in 2013, latest year for which data is available

What needs to be done?

- Reduce the need to travel by personalized modes and boost public bus transport
- Until recently the main function of public bus transport was to satisfy the individual needs of the less affluent members of society, but now it has to contribute for congestion relief, road safety, and environmental preservation
- This requires a fundamental change of emphasis to fulfill its new role of attracting enough people away from the cars, two-wheelers, auto-rickshaws, and taxis
- To retain existing passengers and attract people away from private and para-transit modes, public bus transport operator should try to understand the problems faced by commuters with the existing services and incorporate the changes to improve their satisfaction
- Therefore, this study not only tries to assess the passenger satisfaction but also investigate the service quality attributes that influence passenger satisfaction with the public bus transport services in Lucknow

What needs to be done?...

- The study also tries to evaluate the relative importance of service quality attributes to find out the priority for service quality improvements to enhance passenger satisfaction
- Public bus transport services in Lucknow is provided by the Lucknow Mahanagar Parivahan Sewa (Lucknow Metropolitan Transport Service) which is under the control of publicly owned UPSRTC
- Lucknow Mahanagar Parivahan Sewa started its service in 2005 with a fleet strength of 100 buses, thanks to JNNURM project of the Central Government of India. Presently, it has a fleet strength of 300 buses which operate on around 35 routes
- All the buses operate with CNG; out of theses 300 buses, 20 are AC low-floor, 90 are non-AC low-floor, 60 are semi low-floor, and 120 are mini-buses

The Data

- The study is based on primary data collected from 148 respondents of Lucknow city during the period May to July, 2014
- A self-rated questionnaire was used for the study; respondents were asked to rate their overall satisfaction with the bus transport services and the factors affecting the same
- A seven point Likert type scale where 'delighted' equals 7, 'pleased' equals 6, 'mostly satisfied' equals 5, 'neither satisfied nor dissatisfied (neutral)' equals 4, 'mostly dissatisfied' equals 3, 'unhappy' equals 2, and 'terrible' equals 1 was used for the rating
- Apart from this, respondents were also asked about their age, gender, and employment status. Respondents were systematically sampled and administered the questionnaire across the five spatially-segregated and randomly selected major bus stops (Alambagh, Charbagh, Polytechnic Chauraha, Engineering College, and Kaiserbagh)

The Data...

- Out of 148 respondents, 84 were transit-dependent riders and 64 were choice-transit riders
- The sample constitutes 59.5% male and 40.5% female
- Age of the respondents varies from 15 to 70 years, with average age of 37 years. However, 90% of respondents are younger than 55 years
- The sample has respondents with varied employment status; 30% of them are employed either in government or public sector, 12% in the private sector (9% in the organized private sector and the remaining in the unorganized private sector), and 12% are self-employed
- Besides employed people, sample also constitutes people who are not in the work force (44% including 26% students and 5% pensioners)

The Data...

- **Factors** (which are assumed to affect the overall satisfaction with public bus transport services) **included in the questionnaire are as follows**

Factor code	Factor description
X ₁	Availability of seats in buses
X ₂	Enough leg-space in buses
X ₃	Frequency of bus service
X ₄	Short waiting time at bus stop
X ₅	Facilities inside buses are in good condition
X ₆	Bus stops have enough shelters
X ₇	Ceiling heights of buses are comfortable
X ₈	Buses are well maintained
X ₉	Short passenger walking distance to bus stops
X ₁₀	Sufficient benches available at bus stops
X ₁₁	Sufficient number of buses in city
X ₁₂	Affordable fare
X ₁₃	Safety of passengers on board
X ₁₄	Not afraid of being pick-pocketed on bus
X ₁₅	Buses provide short travel time
X ₁₆	Drivers and conductor behave well
X ₁₇	Buses are clean inside
X ₁₈	Sense of personal safety (vis-à-vis IPTs such as auto-rickshaws, e-rickshaws, Vikrams, and taxis)
Y	Overall satisfaction with public bus transport services

Level of people's satisfaction with public bus transport services and factors affecting the same

Factors	Mean	Coefficient of variation
Overall satisfaction with public bus transport services (Y)	2.9	0.43
Availability of seats in buses (X_1)	3.0	0.46
Enough leg-space in buses (X_2)	3.2	0.44
Frequency of bus service (X_3)	3.6	0.41
Short waiting time at bus stop (X_4)	3.4	0.44
Facilities inside buses are in good condition (X_5)	2.6	0.55
Bus stops have enough shelters (X_6)	3.0	0.44
Ceiling heights of buses are comfortable (X_7)	3.9	0.34
Buses are well maintained (X_8)	2.3	0.49
Short passenger walking distance to bus stops (X_9)	3.3	0.42
Sufficient benches available at bus stops (X_{10})	3.1	0.45
Sufficient number of buses in city (X_{11})	3.6	0.43
Affordable fare (X_{12})	4.0	0.40
Safety of passengers on board (X_{13})	3.0	0.47
Not afraid of being pick-pocketed on bus (X_{14})	2.6	0.47
Buses provide short travel time (X_{15})	3.4	0.42
Drivers and conductor behave well (X_{16})	3.3	0.50
Buses are clean inside (X_{17})	2.3	0.60
Sense of personal safety (vis-à-vis IPTs such as auto-rickshaws, e-rickshaws, Vikrams, and taxis) (X_{18})	3.3	0.45

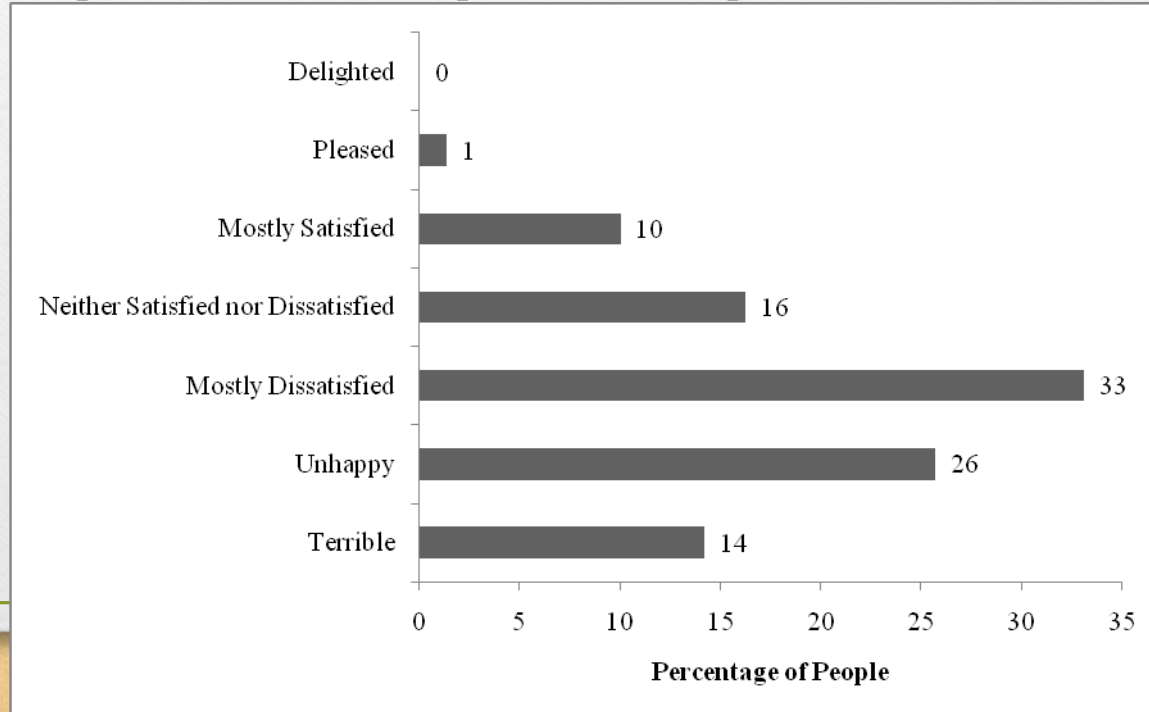
Absolute and relative frequency distribution of satisfaction with public bus transport services and factors affecting the same (N=148)

Variable Code	Terrible (N, %)	Unhappy (N, %)	Mostly dissatisfied (N, %)	Neutral (N, %)	Mostly satisfied (N, %)	Pleased (N, %)	Delighted (N, %)	Mean
Y	21, 14.2	38, 25.7	49, 33.1	24, 16.2	14, 9.5	2, 1.4	0, 0.0	2.9
X ₁	26, 17.6	32, 21.6	36, 24.3	26, 17.6	26, 17.6	2, 1.4	0, 0.0	3.0
X ₂	22, 14.9	21, 14.2	47, 31.8	23, 15.5	30, 20.3	4, 2.7	1, 0.7	3.2
X ₃	17, 11.5	22, 14.9	21, 14.2	43, 29.1	35, 23.6	10, 6.8	0, 0.0	3.6
X ₄	19, 12.8	25, 16.9	34, 23.0	31, 20.9	28, 18.9	10, 6.8	1, 0.7	3.4
X ₅	40, 27.0	38, 25.7	31, 20.9	20, 13.5	14, 9.5	4, 2.7	1, 0.7	2.6
X ₆	22, 14.9	32, 21.6	40, 27.0	34, 23.0	16, 10.8	4, 2.7	0, 0.0	3.0
X ₇	10, 6.8	15, 10.1	24, 16.2	45, 30.4	46, 31.1	8, 5.4	0, 0.0	3.9
X ₈	40, 27.0	46, 31.1	40, 27.0	18, 12.2	2, 1.4	1, 0.7	1, 0.7	2.3
X ₉	25, 16.9	11, 7.4	38, 25.7	48, 32.4	19, 12.8	7, 4.7	0, 0.0	3.3
X ₁₀	24, 16.2	23, 15.5	44, 29.7	29, 19.6	22, 14.9	6, 4.1	0, 0.0	3.1
X ₁₁	18, 12.2	27, 18.2	16, 10.8	28, 18.9	47, 31.8	12, 8.1	0, 0.0	3.6
X ₁₂	10, 6.8	16, 10.8	35, 23.6	23, 15.5	36, 24.3	20, 13.5	8, 5.4	4.0
X ₁₃	23, 15.5	37, 25.0	28, 18.9	39, 26.4	14, 9.5	5, 3.4	2, 1.4	3.0
X ₁₄	33, 22.3	34, 23.0	46, 31.1	25, 16.9	8, 5.4	2, 1.4	0, 0.0	2.6
X ₁₅	19, 12.8	23, 15.5	27, 18.2	46, 31.1	23, 15.5	9, 6.1	1, 0.7	3.4
X ₁₆	32, 21.6	16, 10.8	27, 18.2	35, 23.6	20, 13.5	18, 12.2	0, 0.0	3.3
X ₁₇	55, 37.2	35, 23.6	36, 24.3	10, 6.8	4, 2.7	8, 5.4	0, 0.0	2.3
X ₁₈	25, 16.9	19, 12.8	34, 23.0	35, 23.6	25, 16.9	10, 6.8	0, 0.0	3.3

Level of satisfaction

- People of Lucknow are mostly dissatisfied with the existing public bus transport services (2.9)
- 73% were dissatisfied (14% felt terrible, 26% were unhappy and 33% were mostly dissatisfied)
- Only 11% respondents felt satisfaction and none of the respondents felt delighted

People's satisfaction with public bus transport services in Lucknow



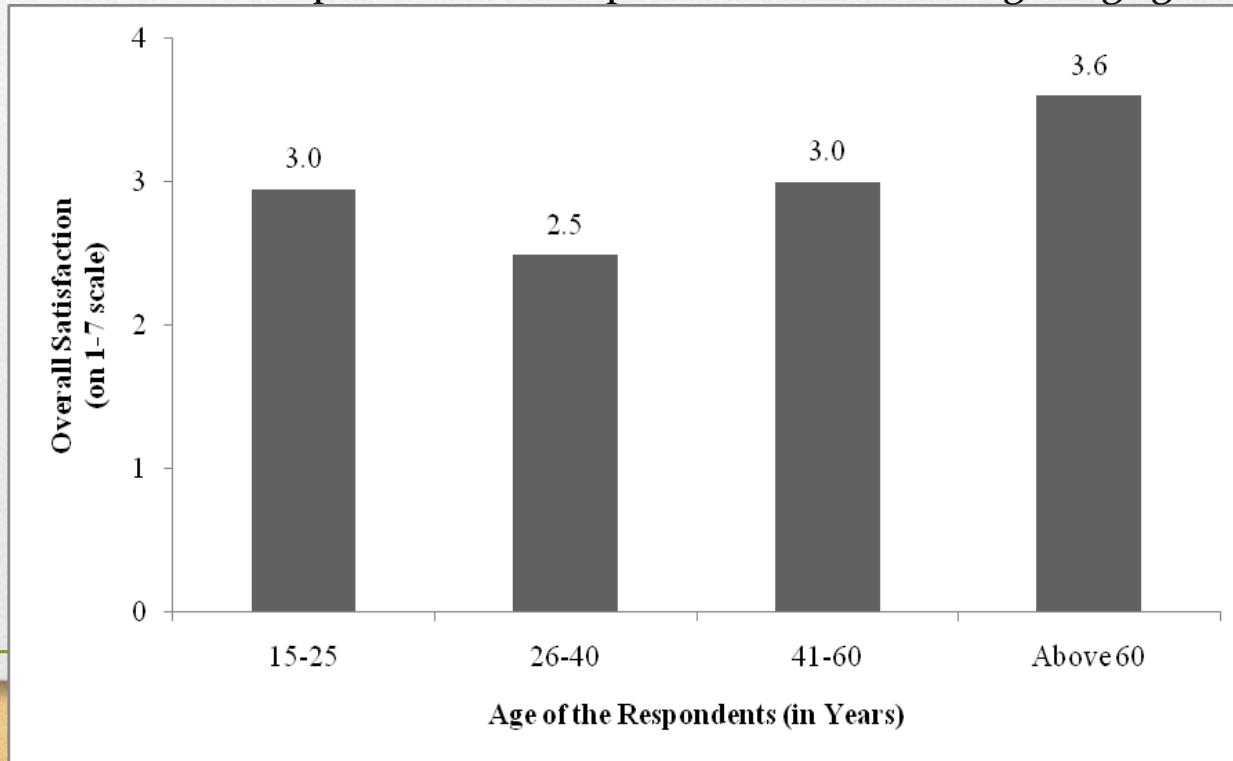
Level of satisfaction...

- Specific service quality attributes that affect passenger satisfaction are also poorly perceived
- For instance, variable X_{17} (buses are clean inside), with a mean score of 2.3 (<4.0) recorded 37.2 percent under 'terrible', 23.6 percent under 'unhappy', and 24.3 percent under 'mostly dissatisfied', i.e., more than 85 percent people are dissatisfied with the cleanliness inside buses
- Similarly, 85 percent respondents perceive that buses are ill-maintained, more than 76 percent are afraid of being pick-pocketed during their journey, and close to 74 percent feel that the facilities inside buses are not in good condition
- Only two variables somewhat met the expectation of passengers; X_{12} (affordable fare), with a mean score of 4.0 and X_7 (ceiling height of buses are comfortable), with a mean score of 3.9. None of the variables could exceed the mean score of 4

Level of satisfaction...

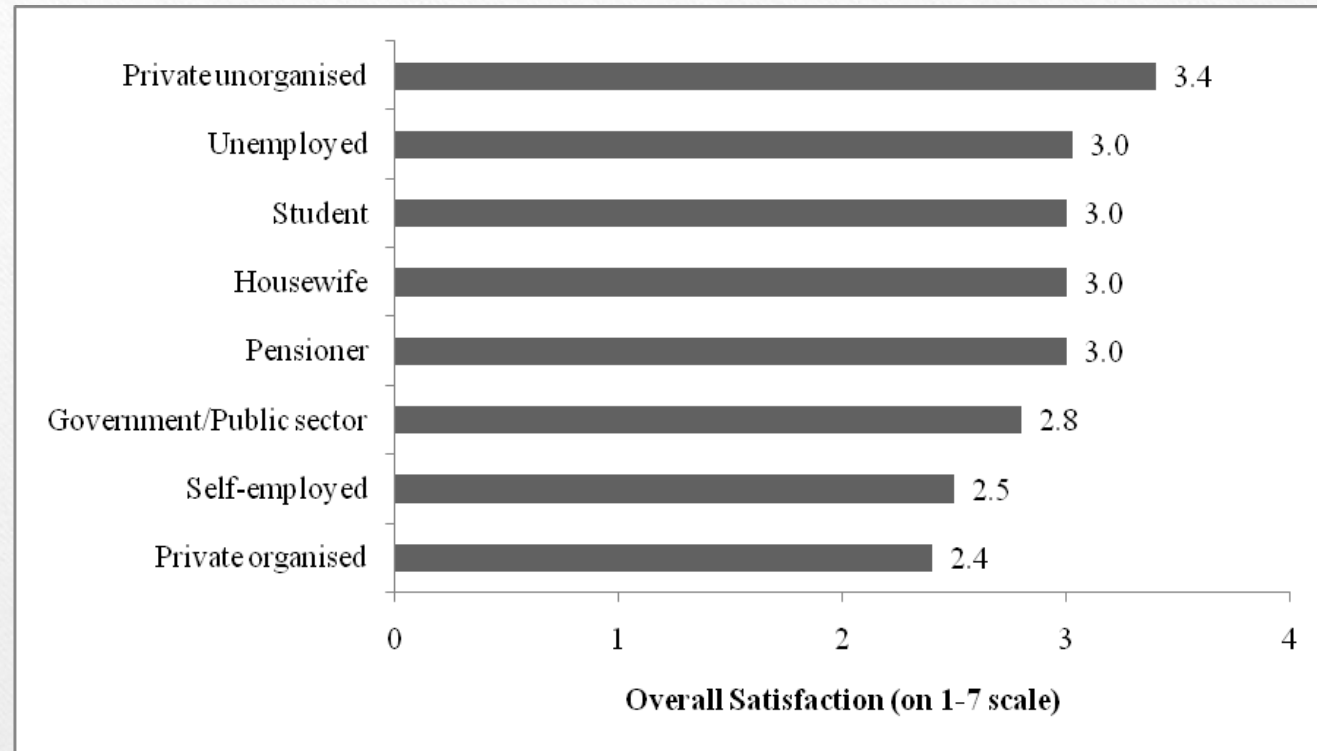
- However, the level of satisfaction defers according to **socio-economic and demographic profiles of the respondents**
- If we compare the overall satisfaction with public bus transport services of males with females, we found that **females experienced marginally higher level of satisfaction**

Satisfaction with public bus transport services according to age group



Level of satisfaction...

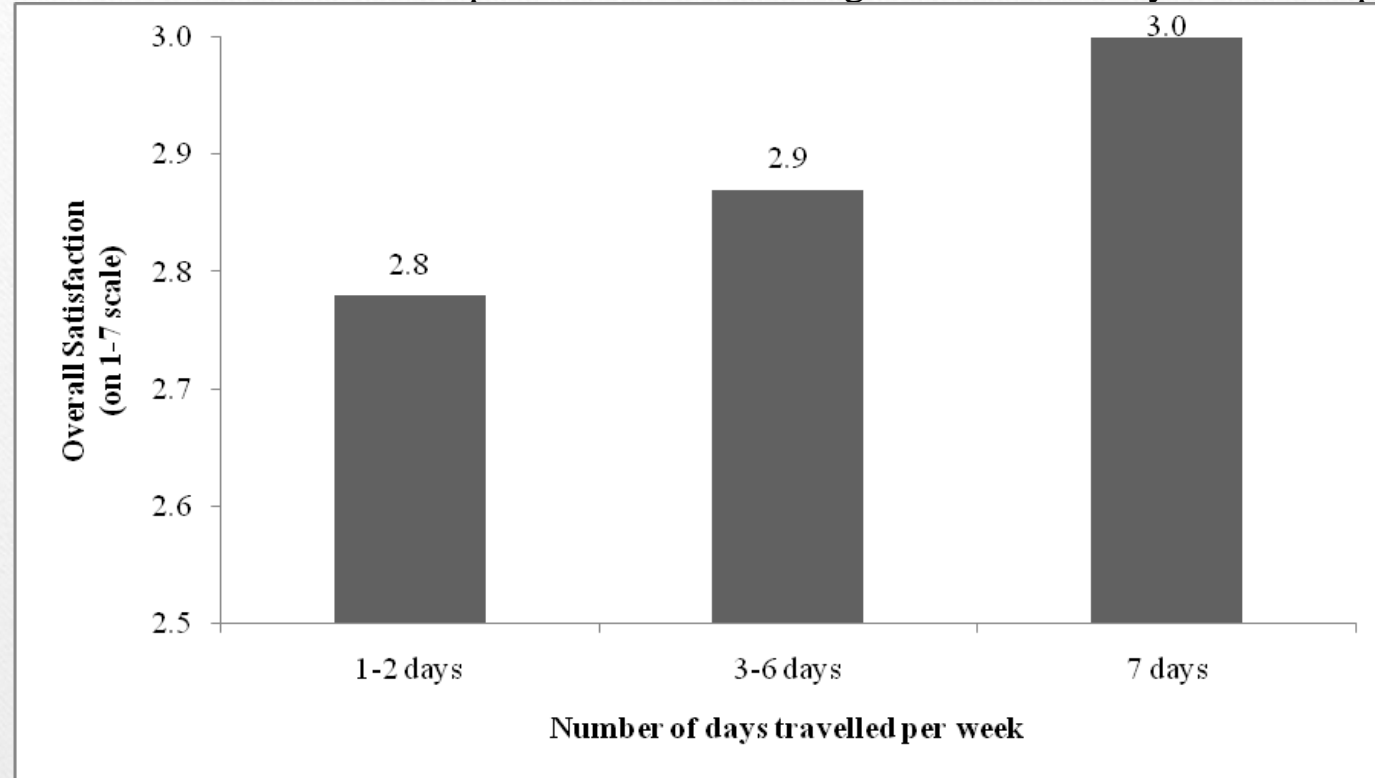
Satisfaction with public bus transport services according to employment status



- In general, relatively economically well-off people rated public bus transport service quality lower than the worse off ones
- This may be because expectation about the service and degree of satisfaction depends on people's economic wellbeing and consequently on their employment status

Level of satisfaction...

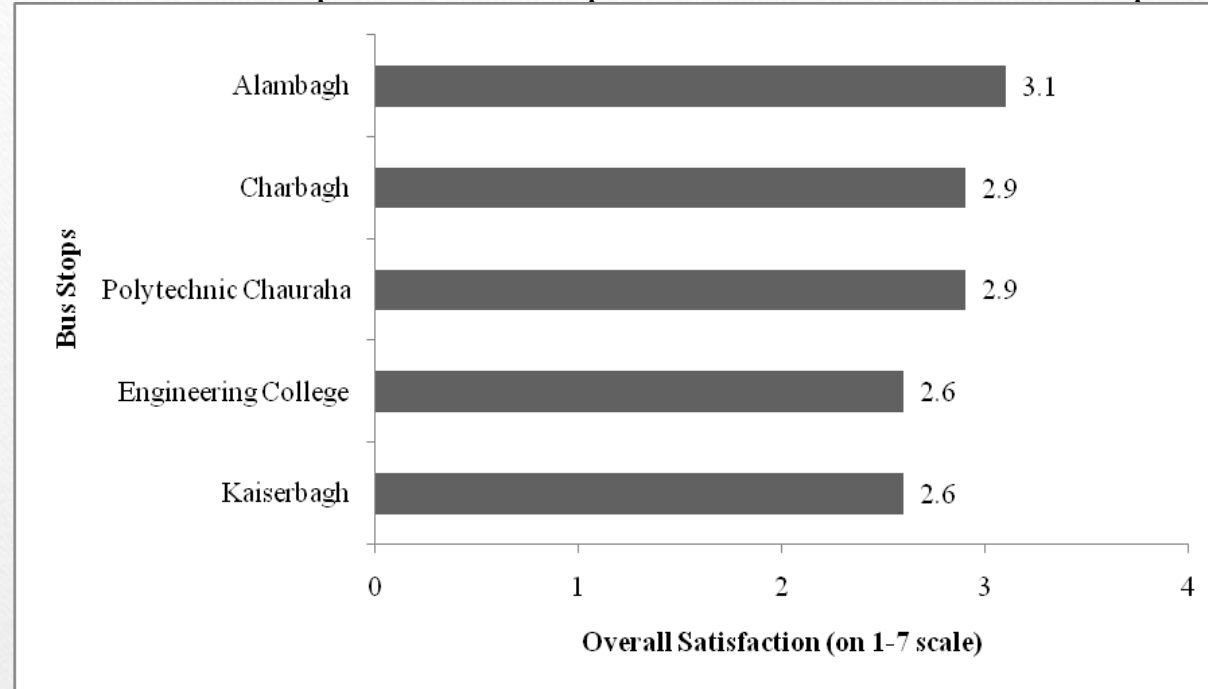
Satisfaction with bus transport services according to number of days travelled per week



- People who travelled daily in public bus transport buses have higher perception about the prevailing services than those who travelled three to six days per week or one to two days per week
- Choice dependent riders have lower perception (2.7) about existing services than the transit dependent riders (3.0)

Level of satisfaction...

Satisfaction with public bus transport services at different bus stops in Lucknow



- This shows that commuters are not satisfied with overall services at any bus stop. However, Alambagh, being the main bus stop of Lucknow, has relatively better facilities for the commuters
- Moreover, nearly 70% of the respondents told that their quality of life is indeed affected by the public bus transport services (which shows that public transport has potential to create not only economic and environmental benefits but also social benefits)

Principal Component Analysis

PCA is simply a **variable reduction procedure** ... it replaces the **original variables** by a smaller no of **principal components** which are linear combinations of the original variables

- PCA is undertaken in cases where there is **sufficient correlation among the original variables**. Also, PCA requires **sample size** to be **greater than 100 or at least 5 times the number of variables**
- In PCA, most commonly used criterion to retain number of components/factors is the **eigenvalue-one criterion** (components with eigenvalues greater than 1 are retained) along with **factor loadings above say 0.50**
- The retained factors/components are rotated orthogonally to make it easier to interpret the retained components. The first component extracted in a principal component analysis accounts for a maximal amount of total variance in the observed variables followed by succeeding components...

Principal Component Analysis...

- This study uses **rotated PCA method** (using **varimax method** of orthogonal rotation) to reduce the 18 selected factors into few principal components (**5 in this case**)
- The 5 components together explained approximately 55 per cent of the total variance.
- All the **five components have positive loadings** on their respective significant variables

Total variance explained by different components

Principal Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.293	18.3	18.3	2.435	13.5	13.5
2	2.018	11.2	29.5	2.111	11.7	25.2
3	1.825	10.1	39.6	1.920	10.7	35.9
4	1.543	8.6	48.2	1.826	10.2	46.1
5	1.196	6.7	54.9	1.583	8.8	54.9

Principal Component Analysis...

Factor loadings of the retained components on the original variables after orthogonal (varimax) rotation

Variable Code	Principal Component				
	1 (comfort and safety in buses)	2 (adequacy of the capacity of public bus transport services)	3 (orderly and clean environment inside buses)	4 (elegant design of buses and bus stops)	5 (accessibility to public bus transport services)
X ₁	56*	27	-1	29	1
X ₂	72*	13	19	14	23
X ₃	38	29	-27	35	52*
X ₄	6	15	-3	-3	86*
X ₅	-4	-22	47	8	54*
X ₆	2	-26	31	69*	11
X ₇	23	-3	-13	74*	-4
X ₈	5	25	66*	2	-12
X ₉	7	76*	14	-4	5
X ₁₀	-1	78*	6	-6	0
X ₁₁	15	54*	-26	37	20
X ₁₂	-14	9	-48	27	23
X ₁₃	68*	-16	0	0	15
X ₁₄	79*	-9	0	-15	-13
X ₁₅	6	26	-21	41	2
X ₁₆	-10	37	40	38	8
X ₁₇	13	-1	71*	-3	23
X ₁₈	48	14	10	15	-4

Note: The original values are multiplied by 100 and rounded off to the nearest integer.

Original values greater than 0.5 are flagged by an ‘*’

Principal Component Analysis...

- **Component 1** has an eigenvalue of 2.435 and accounts for 13.5 percent of the total variance. This component has high positive loadings on availability of seats in buses (X_1), enough leg-space in buses (X_2), safety of passengers on board (X_{13}), and not afraid of being pick-pocketed on bus (X_{14}). Component 1 points to the fact that comfort and safety during travel have significant influence on passengers' satisfaction. Thus, this component can be called as "**comfort and safety in buses**".
- This shows that **security on board and comfort level provided by Lucknow city buses is a major concern** (needs to be addressed to increase passenger satisfaction and consequently patronage in the use of public bus transport services in the city); in general, passenger discomfort worsens during peak hours when many passengers have to travel standing all the way in crowded condition. Chances of being pick-pocketed gets increased with discomfort level when many passengers travel in standing.

Principal Component Analysis...

- Component 2 has an eigenvalue of 2.111 and it explains 11.7 percent of the total variance. This component is related to "adequacy of the capacity of public bus transport services".
- Component 2 reveals that passengers' satisfaction gets reduced if they perceive inadequacy of the capacity of public bus transport services to serve their needs.
- In general, 600 to 700 buses per million population are required for adequate supply of bus transport services in cities; therefore, Lucknow needs around 1700 buses for adequate supply of bus transport services in the city.
- Unavailability of sufficient number of buses is reflected in the long waiting lines, the frantic struggle to board the bus, and the unavailability of seats particularly during peak hours. If sufficient number of buses are provided, enabling passengers to reach their destinations comfortably and on time, it will interest more people to use public transport buses for their daily travel needs.

Principal Component Analysis...

- Component 3 extracted from the analysis includes buses are well maintained (X_8) and buses are clean inside (X_{17}). This component has eigenvalue of 1.920 and accounts for 10.7 percent of the total variance. It mainly describes the orderly and clean environment inside buses.
- In general, Lucknow Mahanagar Parivahan Sewa lacks in cleanliness of both interior as well exterior of its buses. Buses are rarely clean; buses don't have trash cans on them, and sometime, movement of cockroaches, wet seats, and bad smell are noticed.
- Findings of passenger survey reveals that cleanliness of the bus should be considered very important, more important than cost of the trip, frequency of service, and facilities at bus stops for many riders.
- Therefore, Lucknow Mahanagar Parivahan Sewa should pay serious attention to orderly and clean environment inside its buses.

Principal Component Analysis...

- Component 4 is related to facilities at bus stops and design and dimension of buses (low ceiling height of buses).
- Very few bus stops in Lucknow offer appropriate physical structures and facilities for riders; many bus stops do not even have shelters to protect passengers from sun, rain, dust, and air pollution. There are very few bus stops with appropriate number of benches; many passengers have no place to sit for a long wait at bus stops, so there is no alternative but to remain standing.
- It's amply clear that unless bus stop facilities are improved adequately, there is no way private vehicle users particularly car owners can be attracted towards public bus transport services.
- Therefore, Lucknow Mahanagar Parivahan Sewa should start improving its bus stops and go for elegant design of buses and bus stops to attract passengers from all sections of society.

Principal Component Analysis...

- Component 5 is related to accessibility to public bus transport services.
- Passengers perceive that bus routes are not well spread in the city, which in turn reduces the accessibility by bus to many areas of the city. Many passengers require to walk long distances before getting to the nearest bus stop to catch a bus. Many passengers face long waiting time at bus stops due to low frequency of bus services.
- In general, bus riders do not wish to walk very far to their bus stops, and having arrived at the bus stop, they do not wish to wait for very long. Therefore, there is a need to increase the frequency of bus transport services in the city of Lucknow.
- The current situation of accessibility will not encourage people particularly private vehicle users to use public bus transport for their daily travels.

Concluding remarks

- Commuters of Lucknow are mostly dissatisfied with the bus transport services provided by publicly owned operator, Lucknow Mahanagar Parivahan Sewa.
- PCA result reveals that the factors that influence passenger satisfaction are comfort and safety in buses, adequacy of the capacity of public bus transport services, orderly and clean environment inside buses, elegant design of buses and bus stops, and accessibility to public bus transport services.
- The study thus provides a direction for Lucknow Mahanagar Parivahan Sewa administration to identify the areas for improvement so that passenger satisfaction with public bus transport services in Lucknow can be enhanced.



Thank you