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A Methodology to Prioritise Service Quality Attributes for Bus Transit

A case study of Visakhapatnam

by

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Structure of the presentation

- Introduction and research background

- Broad research framework

- Study area and data collection

- Results and analysis
  - RIDIT analysis
  - Exploratory factor analysis
  - Confirmatory factor analysis

- Conclusion

Unlimited wants and limited resources

The study aims to:

Develop a methodology that helps transit operators' to identify bus service quality attributes that influences users' decision to use public bus services.

Research objectives

- *Identify service quality attributes*, both qualitative and quantitative for bus transit users that are of relevance to the city's scenario

- Identify service quality attributes that are *perceived as important to bus users*

- Identify service quality attributes that influence a user's decision to use bus service based on their level of satisfaction

A Typical Public Bus Transport Trip

Plan a trip/ Information
- Information on service
- Information on fare

Accessing the service
- Access infrastructure
  - Pedestrian infrastructure
  - Para-transit or feeder service

Public bus transport trip
- Bus stop
- Bus service
- Bus/Vehicle
- Personnel

Transfer

- Safety and security

- Travel cost

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INSTITUTE OF URBAN TRANSPORT (INDIA)

Bus service quality indicators

Sl. No.	Service Quality Attribute	Definitions
1.	Bus stop proximity	Perceived time taken by a user to walk from one's origin/ destination to the nearest bus stop.
2.	Quality pedestrian infrastructure	Provision of good quality, clean, walkable, wide footpaths
3.	Quality para-transit services	Provision of quality para-transit services that act as a feeder and helps in connecting ones origin/ destination to the nearest bus stop.
4.	Feeder services	Availability of reliable feeder services like smaller sized buses connecting the user's origin/ destination to the nearest bus stop.
5.	Service hours	Perceived daily hours of bus service on an average working day.
6.	Waiting time at the bus stop	Perceived time spent by a user at the bus stop before boarding a bus.
7.	Frequency of service	Refers to the perceived time interval between two consecutive buses.
8.	On-time performance of service	Passenger's perception of buses adhering to scheduled arrival and departure timings based on past experience.
9.	Boarding-alighting time	Refers to the perceived amount of time a bus should stop at a bus stop even when there are no passengers waiting at the bus stop.
10.	Delay in total travel time	Refers to the perceived delay in journey time in comparison to other modes
11.	Number of transfers	Total number of change in modes that a user undertakes to reach ones destination.
12.	Transfer distance	Perceived time that a user takes to walk from one mode to the other.
13.	Transfer waiting time	Perceived time that a user spends for waiting while changing from one mode to the other.
14.	Crowding level inside the bus stop	Perceived average occupancy inside the bus stop (average number of passengers standing or seating inside the bus stop in terms of its total capacity).
15.	Crowding level inside the bus	Perceived average occupancy inside the bus (average number of passengers standing or seating inside the bus in terms of its total capacity).

Source: Das and Pandit, 2014

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Bus service quality indicators

Sl. No.	Service Quality Attribute	Definitions
16.	Availability of seats at the time of boarding	Perceived percentage of times a user gets a seat when they board a bus on their route.
17.	Time spent standing in a bus before one can avail a seat	Perceived time spent by a user waiting after boarding a bus for a seat.
18.	Route and network information	Provision of route and network information inside buses, at bus stops through information pylons, and through websites and mobile applications.
19.	Arrival and departure information	Provision of real time information on arrival and departure of buses through VMS at bus stops, through websites and mobile applications, and real time information on arrival of next bus stop inside buses.
20.	Real time information on emergencies	Provision of real time information on delay, disruption in service and incidences at bus stops and inside buses.
21.	Fare amount	Perceived amount a commuter spends while undertaking a public transit trip.
22.	Fare structure	Refers to the various ways by which a fare is charged: i. Flat fare- fare is same irrespective of the distance travelled ii. Distance based fare- fare increases as distance increases iii. Zone-based fare- city is divided into concentric zones where fare within each zone is same irrespective of the distance travelled within the zone but fare increases as one travels from one zone to the other, based on the distance traversed
23.	Ease in payment of fare	Refers to the users perception of convenience while paying the fare in terms of point at which fare is being paid, mode of payment, ease in fare calculation.
24.	Bus stop design	Refers to the user's perception of the over-all design features and quality of the bus stops
25.	Bus design	Refers to the user's perception of the over-all design features and quality of buses
26.	Safety and security	Refers to the user's perception of the over-all safety and security of the bus service system

Source: Das and Pandit, 2014

Prioritization techniques adopted

- Factor analysis and multiple regression
- Factor analysis and ordered logit model
- Generalised ordered choice model (GOC)
- Importance-satisfaction analysis
- Structural equation modelling
- Artificial Neural Networks (ANN)
- Integrated SERVQUAL and VIKTOR approach

- Average weighted technique
- Index numbers
- Bayesian networks
- Multinomial logistic regression
- ANOVA
- Manifest analysis and latent analysis
- Classification and Regression Trees (CART) algorithm
- RIDIT analysis

This study uses a combination of RIDIT analysis and factor analysis to identify attributes that are of higher priority to the users

Framework of the study

Literature review
- Identify service quality parameters
- Understanding method of analysis
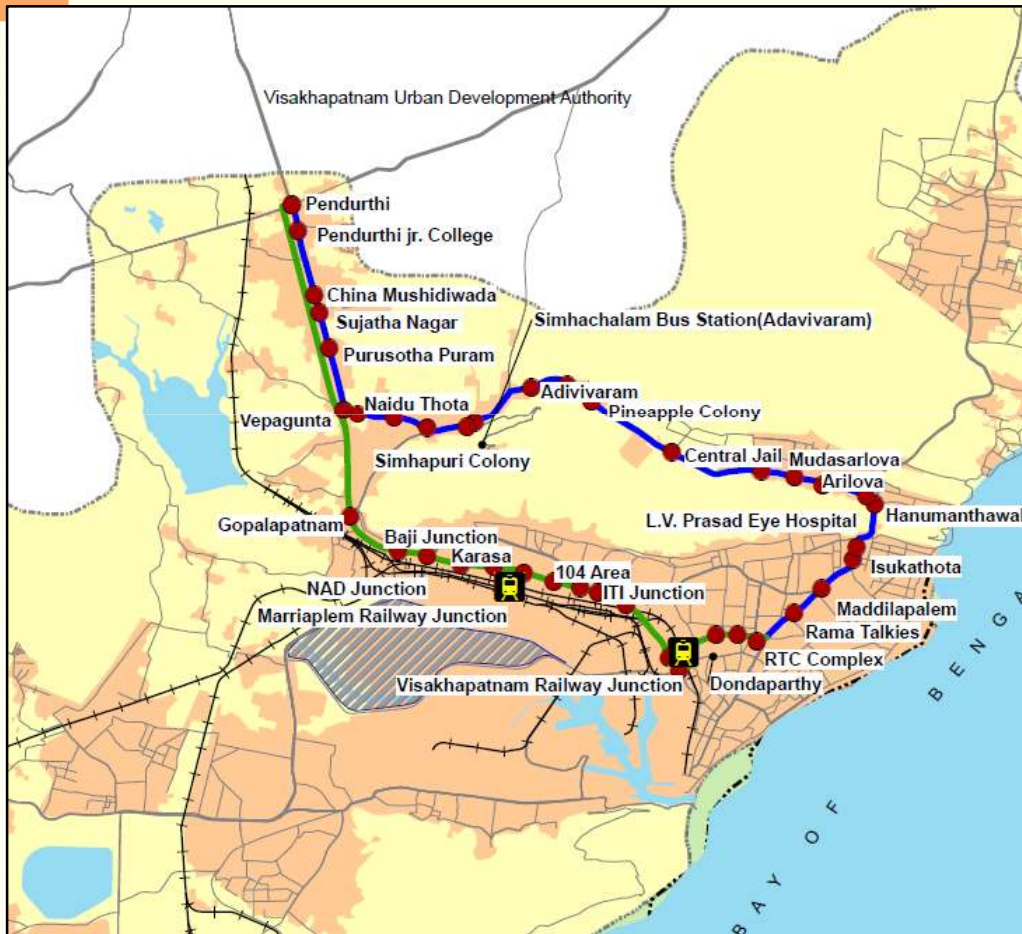- Designing of survey questionnaire

Survey
- User perception of importance and satisfaction of bus service attributes
- Surveys conducted on-board buses and at households

Analysis
- RIDIT analysis to understand perceived importance
- Factor analysis to understand factors influencing satisfaction

Study area

- GVMC area- 681.96 sq. km. (Census 2011)

- Population- 20, 91,811 (Census 2011)

- Bus service operator- APSRTC

- No. of bus routes- 121

- Bus fleet size- 670

- Passengers per day -2.9 lakh

- Proposed services- 2 BRT corridors
    - Pendurthi Transit Corridor (20.4 km) and
    - Simhachalam Transit Corridor (22.6 km)

APSRTC bus in Visakhpatnam

Bus stops along the BRT corridor are partially enclosed structures with specific entry and exit points to the bus

Most buses have physical segregation for men and women in the form of a door

Sample details

Total sample size	380		
Socio-economic Groups	**Percentage of respondents**	**Socio-economic Groups**	**Percentage of respondents**
Gender of respondents		**Vehicle ownership of respondents**	
Male	74	Vehicle owner	59
Female	26	Vehicle non-owner	41
Age of respondents		**Income of respondents**	
<30 years	40	Low income	45
30- 59 years	55	Middle income	53
≥60 years	5	High income	2

RIDIT Analysis

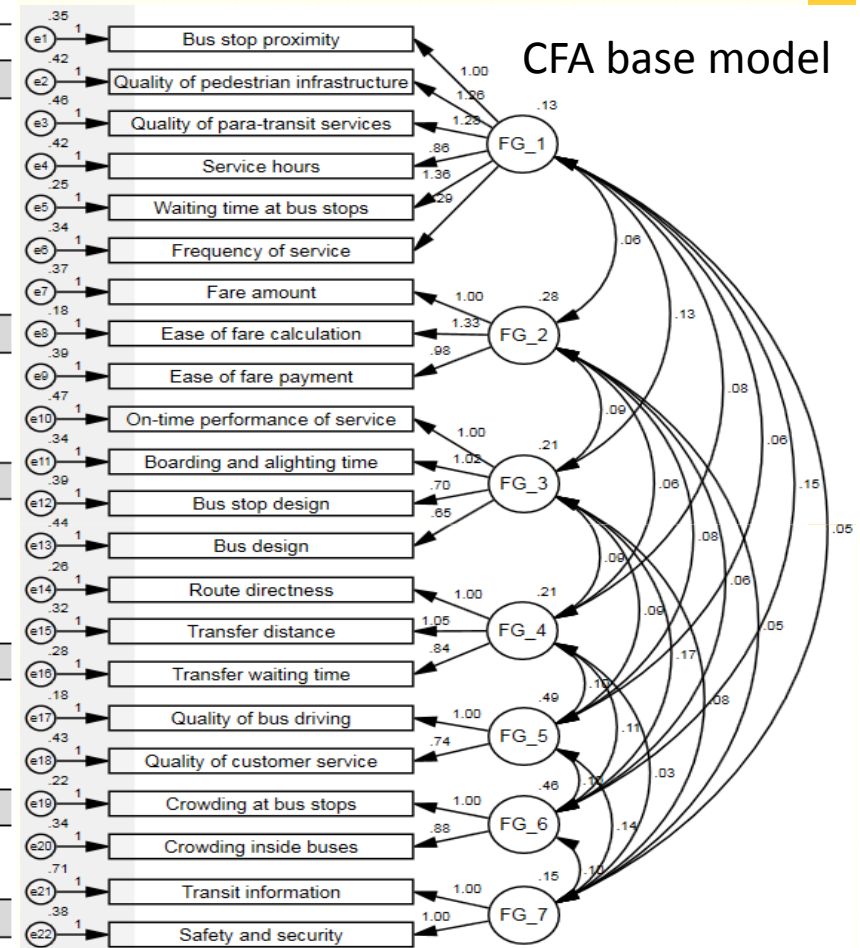| Service Attribute	RIDIT Score	RIDIT Rank
Ease in fare calculation	0.5948	1
Ease in fare payment	0.5924	2
Frequency of service	0.5466	3
Fare amount	0.5349	4
Transfer waiting time	0.5183	5
Waiting time at bus stops	0.5149	6
On-time performance of service	0.5122	7
Safety and security	0.5100	8
Crowding at bus stops	0.5097	9
Quality of pedestrian infrastructure	0.5093	10
Quality of customer service	0.5085	11
Transfer distance	0.5074	12
Quality of para-transit services	0.5023	13
Bus stop design	0.4934	14
Bus design	0.4870	15
Quality of bus driving	0.4838	16
Transit information	0.4762	17
Service hours	0.4757	18
Crowding inside buses	0.4704	19
Delay in total journey time	0.4571	20
Boarding and alighting time	0.4400	21
Proximity to bus stops	0.4334	22
Route directness	0.4217	23

Service quality attributes perceived as important:

- **Fare services**

- **Service operation** attribute related to waiting at bus stops

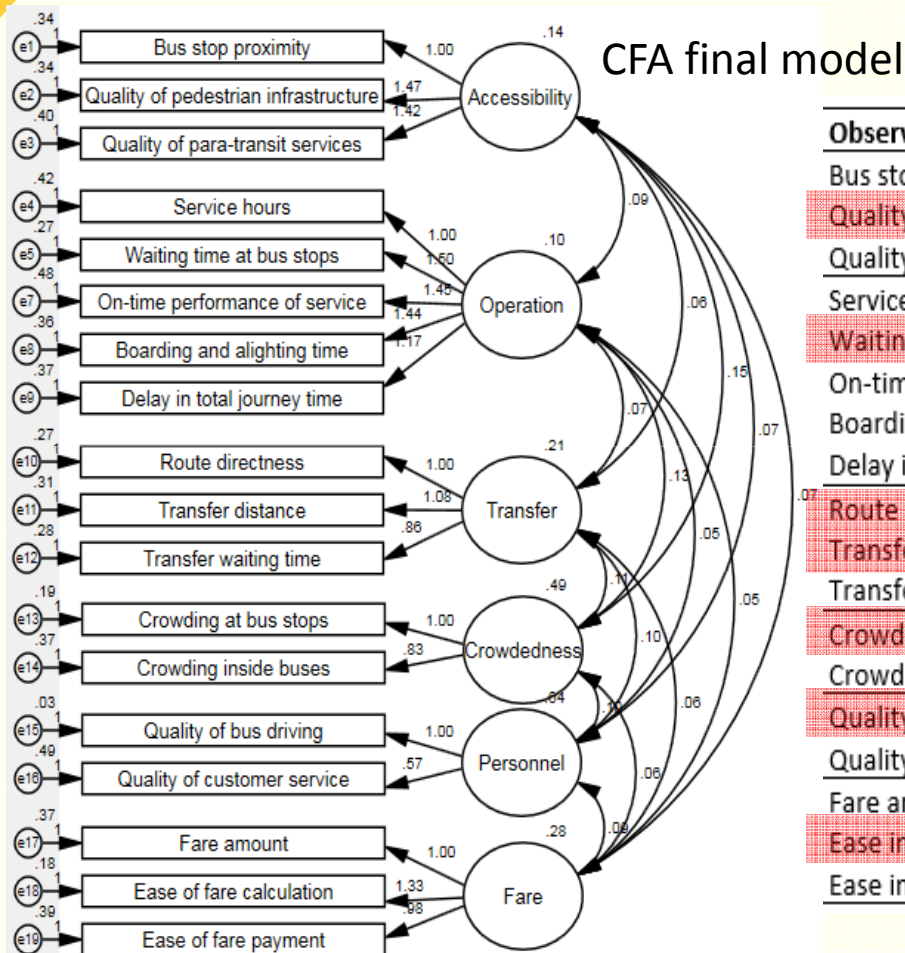- **Safety and security**

- **Accessibility**

Exploratory Factor Analysis

Bus Service Attributes	Factor Groups						
	1	2	3	4	5	6	7
Factor Group 1 (TVE: 11.70%; α: 0.744)							
Quality of para-transit services	0.723						
Quality of pedestrian infrastructure	0.713						
Frequency of service	0.557						
Waiting time at bus stops	0.536						
Bus stop proximity	0.518						
Service hours	0.489						
Factor Group 2 (TVE: 9.73%; α: 0.754)							
Ease in fare calculation		0.841					
Ease in fare payment		0.796					
Fare amount		0.736					
Factor Group 3 (TVE: 8.98%; α: 0.593)							
On-time performance of service			0.657				
Bus design			0.584				
Bus stop design			0.574				
Boarding and alighting time			0.557				
Factor Group 4 (TVE: 8.88%; α: 0.673)							
Transfer waiting time				0.768			
Transfer distance				0.757			
Route directness				0.692			
Factor Group 5 (TVE: 7.64%; α: 0.694)							
Quality of bus driving					0.802		
Quality of customer service					0.772		
Factor Group 6 (TVE: 7.42%; α: 0.786)							
Crowding inside buses						0.831	
Crowding at bus stop						0.774	
Factor Group 7 (TVE: 6.73%; α: 0.351)							
Safety and security							0.670
Transit information							0.657

KMO: 0.798; Bartlett's test of sphericity: 2108.331; p-value: 0.000

CFA base model

Chi square- 442.35; df- 188; RMR- 0.035; GFI- 0.902; AGFI- 0.869; CFI- 0.868; RMSEA- 0.60

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Confirmatory Factor Analysis

CFA final model

Observed Variable	Latent Variable	RW	SE	P	SRW
Bus stop proximity		1.000			0.536
Quality of pedestrian infrastructure	Accessibility	1.469	0.198	0.000	0.684
Quality of para-transit services		1.423	0.191	0.000	0.642
Service hours		1.000			0.432
Waiting time at bus stops		1.505	0.217	0.000	0.665
On-time performance of service	Service operation	1.448	0.229	0.000	0.545
Boarding and alighting time		1.436	0.214	0.000	0.596
Delay in total journey time		1.175	0.190	0.000	0.512
Route directness		1.000			0.658
Transfer distance	Quality of transfer	1.080	0.133	0.000	0.660
Transfer waiting time		0.861	0.110	0.000	0.597
Crowding at bus stop		1.000			0.850
Crowding inside buses	Crowdedness	0.830	0.095	0.000	0.694
Quality of bus driving		1.000			0.977
Quality of customer service	Quality of personnel	0.567	0.164	0.000	0.544
Fare amount		1.000			0.655
Ease in fare calculation	Fare system	1.329	.135	0.000	0.858
Ease in fare payment		0.977	0.099	0.000	0.637

Chi square- 203.25; df- 120; RMR- 0.028;
GFI- 0.944; AGFI- 0.920; CFI- 0.947;
RMSEA- 0.043

Conclusion

Service Attribute	RIDIT Score
Ease in fare calculation	0.5948
Ease in fare payment	0.5924
Frequency of service	0.5466
Fare amount	0.5349
Transfer waiting time	0.5183
Waiting time at bus stops	0.5149
On-time performance of service	0.5122
Safety and security	0.5100
Crowding at bus stops	0.5097
Quality of pedestrian infrastructure	0.5093
Quality of customer service	0.5085
Transfer distance	0.5074
Quality of para-transit services	0.5023
Bus stop design	0.4934
Bus design	0.4870
Quality of bus driving	0.4838
Transit information	0.4762
Service hours	0.4757
Crowding inside buses	0.4704
Delay in total journey time	0.4571
Boarding and alighting time	0.4400
Proximity to bus stops	0.4334
Route directness	0.4217

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Thank you