

Criteria of Providing Means of Public Transport System in Million Plus Cities in India

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Abstract— The vehicle population is quickly increasing in our country as all over the world which reveals the high load on the roads beyond their capability. Rapid increases in vehicle population have put enormous strains in all urban roads in all million plus cities in India. High vehicle ownership and poor supporting public transport facilities are in particularly in the urban cities where the population is between 1 to 2 million. To alleviate traffic congestion problems, several modern cities around the world take measures into consideration including increased investment in public transport and construction of new urban mass transit systems underground or above ground (either at surface or elevated). There is no one right transit decision. The best designed system will depend upon local conditions and local preferences. Geographical and physical situation, topological configuration, financing, know-how, technical capability, institutional capacity, and political constitute local conditions whilst low cost, high customer service level, rapid journey, convenience, comfort, frequent service, safety, and security constitute passengers’ preferences. Therefore selecting an appropriate mass transit system necessitates a several conflicting criteria decision aid which will take all these conditions and preferences into consideration. This study aims such a recommendation by evaluating suitable mass transit systems for urban transit based on the related criteria. In accordance with the proposed decision making process, the research group act as decision analysts and interact with experts in transportation sector for acquiring their knowledge and expertise.

Key words: Public transport systems, travel behavior, demand parameters

I. INTRODUCTION

In India, according to census 2011 total population is 1210 million; the growth rate is 17.64% from last decade. In 1210 million population approximately 724 million (59.83%) lives in rural areas and 377 million (41.17%) living in urban areas (Census, 2011). So the population of urban area increased rapidly per decade. The number of metropolitan urban cities with a population topping one million has increased from 5 in 1951 to 23 in 1991. This is anticipated to increase further to 51 by the year 2021(WSA Report, 2008).

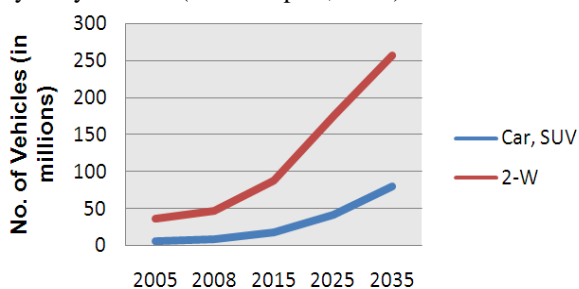


Fig. 1: Forecast of Vehicle Populations In India
Source: Ministry of Urban Transport 2010

Increase in population of Indian cities, transport demand is also increasing parallel, although conditions of cities different from each other, but transport demand are the same at certain basic substances like increase in urban population, economic development, industrial and commercial activities, etc.

The rapid growth of India’s urban population as in other developing countries has generated an enormous need for efficient public transport services to carry high volumes of passengers through dense, congested urban areas. By 2001 over 285 million Indians lived in cities, more than in all North American cities combined (Office of the Registrar General of India 2001). There has been especially rapid growth of the very largest metropolitan areas such as Mumbai (Bombay), Kolkata (Calcutta), and Delhi, which now exceed 10 million residents each. Chennai (Madras), Hyderabad, Ahmedabad, and Bangalore each have more than 5 million residents. And 35 metropolitan areas have populations exceeding 1 million, almost twice as many as in 1991. Since large cities are far more dependent on public transport than small cities, the need for public transport services has increased faster than overall population growth.

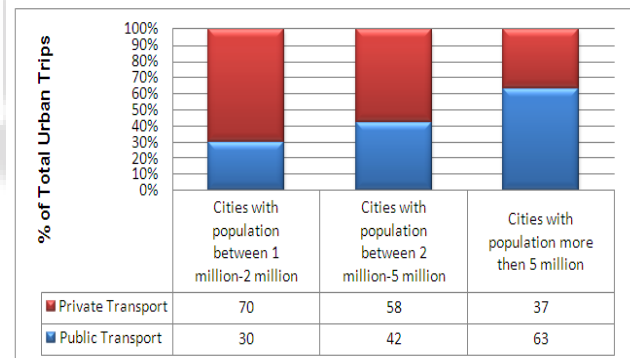


Fig. 2: Details of Urban Trips in Indian Cities (Based on City Size)

Source: Census 2011

Our country has to improve its urban infrastructure to achieve objectives of economic development. However, most of the cities in India have inadequate infrastructure. Urban transport is one of the major problems, affecting the mobility of people and economic growth of the urban areas.

The Policy of public transport system primarily focuses on the mobility of people and not the mobility of vehicles. This will require the public transportation system to be more attractive to use. The challenge for improved transport system is to provide good quality service at an affordable price. It is important to evaluate alternative public transport technologies in the context of city characteristics. The public transport options vary between low cost buses to high cost rail metros. Moreover the shape of a city is very important for selecting the appropriate mode of transport and capacity building is a very important factor in introducing and implementing public transport system.

II. LITERATURE REVIEW

In this literature review of previous case studies and research works are included which demonstrate the different methods of evaluation of mode choice analysis.

A. Factors Influencing the Mode Choice:

The factor may be listed under three groups:

- 1) Traveler characteristics: the following features are generally believed to be important
 - Car availability or ownership, possession of a driving-licence.
 - Household structure (young couple, couples with children, retired, singles, etc);
 - Income; Decisions made elsewhere for example the need to use car at work, take children to school, residential density.
- 2) Trip characteristics: mode choice is strongly influenced by:
 - The trip purposed for example journey to work is normally easier to undertake by public transport compared to other journey because of its regularity.
 - Time of the day when the journey is undertaken; late trips are more difficult to accommodate by public transport.
- 3) Service characteristics: these can be divided into two categories:
 - Quantities factors
 - Relative travel time
 - Vehicle travel time
 - Waiting and walking time by each mode
 - Relative monetary cost (fare, fuel and direct cost)
 - Availability of public transport and cost of parking
 - Qualitative factor
 - Comfort
 - Convenience
 - Reliability
 - Safety etc.

S.N.	Country	Study	Parameters
1	Chennai, India (APRIL 2008)	Modelling for Optimization of Urban Transit system: A case study	Travel Time, Travel Cost and Accessibility
2	Hyderabad, India(2006)	Discrete Choice Model for Optimization of Urban Transit System	Travel Time, Travel Cost and Accessibility
3	Bangalore, India(2006)	Modelling Travel Demand in a Metropolitan City: Case Study of Bangalore,	PCTR, Modal Split, Trip length, Population

4	New South Wales(2001)	Public Transport or Private Vehicle: Factors That Impact on Mode Choice	Socio-demographic characteristics of traveller, Trip purpose, Access and frequency, Parking, travel time, convenience and cost
5	Bangkok and Manila(2002)	Characteristics of Mode Choice within Mass Transit Catchments Area	stop distance, total travel time and total travel cost
6	Delhi, India(2010)	Last mile connectivity for enhancing accessibility of rapid transit system	Accessibility, comfort, cost convenience and journey time
7	Guwahati, India(2011)	Mode choice Modelling for intercity transportation in India: A case of Guwahati to five metro cities	Cost, Income, Purpose of Travel (POT), Level Of Service
8	New Jersey(2009)	New Jersey Public Transportation Ridership: The Effect of Fuel Prices, Infrastructure and Socioeconomic Factors	Per Capita Transit Ridership, real fuel prices, real fare, real GDP growth rates, unemployment rates, real investment
9	China(2006)	Modal Shift of Car Travellers to Buses Based on Bus Priority	convenience, safety, reliability, waiting time, bus service level
10	Bhopal, India(2012)	Optimization of Public Transport Demand: A Case Study of Bhopal	travel time, travel cost , convenience, comfort, accessibility

Table 1: Comparative Analysis in Different Countries For Selecting Parameters Affecting Public Transport Demand

B. Urban Mass Transit Systems:

Urban mass transit systems range from buses operating on streets under normal traffic conditions that are capable, in major cities, of carrying up to 5,000 passengers per hour in one direction at average speeds of approximately 12–15 km/h to fully-grade-separated Metro systems capable of carrying

up to 60,000 passengers per hour in one direction at average speeds of up to 60 km/h (ITA Working Group, 2004). There is a variety of different mass transit systems such as underground metro/subway, light rail, heavy rail, elevated rail, tram, bus-based systems, ferries, etc. Following on from the earlier shift from heavy rail to light rail (Mackett and Edwards, 1996), during the last few years new lines of metro and light rail transit systems have been constructed or extended (Marin and Jaramillo, 2008; Marin and Garcia-Rodenas, 2009) because of increasing mobility and longer journeys due to the growth of cities, traffic congestion in city centers and in entrance corridors. Because of their relatively low cost, light rail transit systems are often preferred to traditional underground metro systems (Bruno et al, 2002). On the other hand, improving bus-based public transport has been considered a more cost-effective option compared to rail investment especially in Asia, Europe, South America and some parts of North America (Currie and Wallis, 2008; Hensher, 2007). Only one type of a transit system cannot be a unique solution to public transportation demand in a city. Public transportation can consist of different urban mass transit systems. What is important here is to construct an integrated transportation network which has inter-connective nodes of different mass transit systems. For each urban transit corridor in the transportation network, suitable mass transit systems can be evaluated and the most appropriate one can be recommended to the decision makers.

C. Different Modes of Public Transport System:

- RTVs/Mini Buses
- Bus transit system
- Articulated buses
- High Capacity bus system
- Trolley buses / Trams
- Light Rail Transit System
- Mass Rapid Transit system

Modal Characteristics	Bus	Maximum Bus Priority	Busway	Tram	Light Rail	Heavy Rail
Maximum capacity	2,500 pphpd	4,000 pphpd	6,000 pphpd	12,000 pphpd	18,000 pphpd	30,000 + pphpd
Capital cost per route km	< £1m	£1m - £2m	£1m - £20m	£15m - £20m	£10m - £45m	£45m - £250m
Operating cost per passenger place km	3.8 p - 8.8 p	2.5 p - 5.8 p	2.5 p - 5 p	1 p - 2.1 p	1 p - 1.4 p	1.5 p - 1.8 p
Average speed	10-14 km/hr	14-18 km/hr	15 - 22 km/hr	15 - 22 km/hr	18- 40 km/hr	18- 40 km/hr
Reliability	Improving	Medium	Good	Medium to Good	Good	Very Good
Roadspace Allocation	Mixed running with traffic	Mixed running and on-road bus lanes	Totally segregated alignment required	Mixed running and on-road tram lanes and totally segregated where available	Very largely on segregated alignments	Totally segregated
Theoretical Land Use 'best fit'	Best suited to lower density dispersed urban form	Best suited to lower density dispersed urban form	Best suited to high demand corridors in medium to low density areas	Higher densities of development, or connecting denser urban centres	Higher densities of development, or connecting denser urban centres	Very high density urban development

Source: Transport for London

Table 2: Characteristics of Different Modes of Public Transport System



1. Heavy Metro



2. Sky bus



3. Bus Rapid Transit System



4. Mono Rail



5. Trams

Fig. 3: Different Modes of Public Transport System

III. METHODOLOGY

A. Study Area:

The selection of the study area plays an important role in finding out the travel behaviour and mode choice behaviour of the commuters.

B. Data Collection:

Questionnaire was designed in order to fit the objectives of this study. The choice sampling procedure was adopted which has been used for transportation, especially for development of mode choice. Samples were drawn at random and various strata of commuters based on sex, income groups and trip length. The data required for the study was collected by home interview survey. Survey data was collected by directly interviewing the commuters working in various public and private sectors. Surveys were conducted at various sub urban regions.

Pilot survey was carried out using samples and analysis and model building was carried out to reveal the deficiencies in the design of the proposed procedure.

C. Preliminary Analysis:

The data collected from the respondents through the questionnaire survey was fed into the computer and appropriate statistical analysis was carried out. The analysis included coding and sorting of the input data. This sorted data was processed in the form of tables and charts. The sorting and processing of the coded data was done using Microsoft Excel. The important socio-economic characteristics such as age, gender, monthly income, vehicle ownership were analyzed.

D. Model Formulation and Validation:

Several statistical techniques are available for developing mode choice models for work trips. Mode choice modeling can be regarded as a pattern recognition problem in which multiple human behavior patterns reflected from explanatory variables determine the choices between alternatives or classes. The variables that are used for model building includes travel mode, travel time, travel cost, sex, number of working members in the household, annual income, comfort, and safety. The dependent variables in this case are discrete and hence linear regression is not appropriate. Modeling generally involves:

- 1) Specification of the model like Logit, Probit etc;
- 2) Identification of variables;
- 3) Considering the form in which the variable enter the utility function; and
- 4) Identifying individual's choice set.

The available data was divided into two parts- testing data and validating data.

IV. CONCLUSIONS

We infer that in the context of Indian cities, the dependence of the urban trips on the public transport is based on numerous parameters like the city size, geographical considerations, land use & functional segregation of activities over the city. Also, due to the previous negligence in the transport planning exercise in case of Small & Medium Cities, there is an absolute need of complete overhauling of the existing transport facilities in these cities, especially in the public transport facilities, so as to make the system efficient for fulfilling the arising transportation demands in the cities & to make them competent for addressing the future demand projections. Also, it'll not only make the existing system efficient, but can also lead towards making the future public transport systems more acceptable & can help in switching the people towards alternative modes of transport.

Commuters are giving more importance to travel time and are likely to travel by the mode which takes less travel time. Travel cost is another important parameter which affects the commuters mode choice. People living in the study area region do not give much importance to cost of travel.

The present study indicated that the work trip travel in the study areas was mainly by means of different modes. The universal choice set was identified as LRTS MRTS, BUS and BRTS. BRTS are preferred more compared to others. There was a good evidence to show that the commuters prefer costlier mode. The perception of travel cost was either low or reasonable.

BRTS comes out to be a successful way of meeting the increasing transit demand as well as sustainable mode of public transport effectively since it has better management with greater speeds as well as is more economic. The quality of buses used, having low floors and air conditioning add to the charm, making the system even more popular by providing extreme comfort along with economical character. Setting up of BRT Systems is also quite cheap as well as easy as compared to MRTS as well as the operational and maintenance expenses are quite low.

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