

Accessibility Measures as a Tool to Improve Public Transport Patronage

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Abstract—Public transport is a critical element of urban transport system. A great emphasis needs to be given to the public transport system as it offers the most efficient utilization of limited resources – energy and land. The success story for any public transport depends upon its reliability, safety and accessibility. Empirical evidences show that better accessibility of public transport results in increase of public transport patronage. Accessibility is a Supply-based activity, thus it is solely depends upon the arrangement of land-uses, spatial growth of the region, and properties of physical transport and traffic system.

In India, commuters spend more time in travelling from origin to their desired destinations. This time is been compensated from their social or professional hours that affects to physical and mental aspects of their life. An accessible public transport can ease individual's life and helps them in time management.

Thus, a critical analysis and a sensitive planning help in making an effective, affordable and reliable public transport system. The paper is an attempt to understand the accessibility as a vital tool while designing an effective Public transport system for any city. The zest is to make accessible transport system to all sections of the society and is also an attempt to make people move from public transport rather than using their private vehicles. For this, the model that counts on Land use and activity of an Individual throughout a day is taken in consideration. An attempt is being made to overlap the model and try to increase the public ridership for public transport system in Nagpur city (Maharashtra).

1. INTRODUCTION

Bus transport is the most desirable and sustainable system, if it is well planned and made high level of accessibility to the larger population with least cost. A flexible, comfortable, easily available and reliable bus service may encourage shift from private vehicles to public transport.

Accessibility is a term often used in transport and land-use planning, and is generally understood to mean approximately 'ease of reaching'. Accessibility is concerned with the opportunity that an individual at a given location possesses to take part in a particular activity or set of activities. Also, strategic execution of accessibility level defines the location of Stops/terminals; thus helps in increasing the patronage to public transport. It has been seen that although the land use and sprawl is changing dramatically but still the Public transport routes (buses) are running on the conventional

routes. At times it is unable to cater the changing demand. Therefore; people spent more time and money on other modes rather than using public transport.

The research was based on the level of accessibility prevailing and further developing the overall network of the city in such a manner that it becomes accessible for all the commuters. It also helps in identifying the loops in the network or finds the alternate routes which can reduce the travel time and distance thus increasing the ridership to the Bus service.

1.1 A Contextual Overview

With a view to understand the relation between the land-use pattern and the ease of accessibility to the transport, a second tier city was selected and Nagpur is one of it. Fig. Nagpur is a ring and radial pattern city. The new development in the last few decades had spread city to the outer areas affecting the travel characteristic and pattern of the people. The bus system in the city runs on the Spoke and Hub arrangement.

The public transport typically consists of Bus system and Para transits. The trip length of the city is about 4.6 km and 5.8 km including and excluding walk trips respectively. The average trip length for walking is 1.29 while the two wheelers are about 6.4 km (*L&T-Ramboll report, 2007*).

2. FRAMEWORK FOR ANALYSIS

Researchers like Geurs and Ritsema defined accessibility as 'the extent to which the land-use transport system enables (groups of) individuals or goods to reach activities or destinations by means of a (combination of) transport model(s). They also explained there are mainly four components (transport, spatial, temporal, individual component) which are related to accessibility.

Thus, apart from the above mentioned parameters, the city is also studied with comprehensive analysis of land-use impact on accessibility and on travelling patterns. This is been done through the survey and secondary data sources, preparing data in geographical information in digital maps and available data on population and potential destinations. The focus is on

individual's accessibility to different places and also to the transport system.

For Accessibility Model, the elements of network system are mainly used:

1. Bus Network Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig.
2. Routes and Stops
3. Transfer/ Travel time Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig. Fig.
4. Bus Frequency and Speed
5. Individual Activity Pattern for a day.

For this case study a point-to-point distance measure is estimated separately for different types of opportunities and different road-users. To understand the total distance which an individual cover to reach his desired destination; the study was divided in three major steps; in which the first combination is from Origin cluster and the nearest Bus stop. Second combination is of Bus stops to all the Bus stops as the commuter will be moving in the network itself; and third combination will be of Bus stop to its nearest destination. Following is the diagram of Link Matrix; Fig.

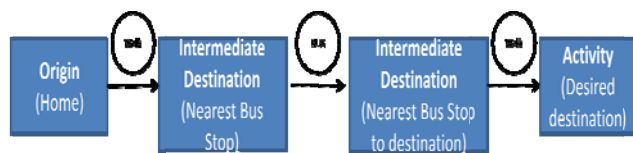


Fig. 1: Conceptual Diagram for Link Matrix

3. DATA ANALYSIS

Data was collected from different agencies including government and private operator. Whereas, the primary survey comprises of Location of commuters, travel time, source of accessing the bus service, economic factor governing mode choice and level of service provided in the existing service.

3.1 Spatial Component

It has been observed that Bazaar culture is still dominating in the city thus the commercial activities are situated in the core of the city; thus the recreational or commercial trips are more concentrated on the central part of the city.

Whereas the service class in the city comes mostly from the fringe of the core area and the labor class travels from the outer parts of the core city. From the revenue data it was made clear that mostly the commuter's travels to longer distance mostly 8-10 km and longest up to 16-18 km. The huge share of revenue collected is from 4-10 km. The movement in the city was observed to be from eastern part of the city to the central part and then get dispersed for their desired destination.

3.2 Travel Pattern and Temporal Components

The travel time from origin to destination ranged from 30 minutes to 60 minutes. Survey showed that Individuals walks from their home to Bus stop for required destination and from Bus stops to their work place. If the travel time to nearest Bus stop is more than 15 minutes than it discourages a person to board the bus service. It was observed that 7% people uses other vehicle to access the bus stop whereas, remaining prefers or are bound to walk Bus services.

As far as travel time is concerned, the total access time is calculated as the combination of factors: combining the walk time from the Home (considering home as origin) to the nearest Bus stop location and the time spent waiting at the Bus stop for the desired service to arrive.

Total Access Time = Walk Time + Average Waiting Time

Where; waiting time is the average time between when a passenger arrives at a stop or station, and the arrival of the desired service.

In the survey, the total access time in most of the cases lies between 15-20 minutes because of long waiting time at Bus stops due to low frequency in outer areas. Longer the total access time to the service, lesser will be the number of passengers using public transport.

3.3 Activity Pattern of an Individual

Survey showed that Individuals spend more time at work related activities as compared in proportion to the time spend in leisure related activities. The respondents spends at an average 8.4 hours/day at work, almost 2 hours/day in total travelling time, and at an average of 4.4 hours/weekends in Recreation/shopping. The average time spend in travelling by the individuals in bus service is 45 minutes per trip with minimum travel by the Service class (40 minutes) and maximum by the Workers (52 minutes).

4. A HOLISTIC APPROACH

The data collected from different agencies and the primary survey conducted on Bus stops, provide the indicators for the existing transport system. In existing system, public opinion was mainly comprises of issues with low frequency, seat availability and demand for direct service. Other issues like overcrowding, seat availability seat availability is also due to low frequency. Whereas, demand for direct service is because of the buses running on conventional route neglecting the change in land use and sprawl. Fig. Thus there need to be an integrated planning approach while routing the public transportation.

It also identified the gap between the prevailing public transport systems running on the old routes irrespective of spatial changes in the city's outer areas.

The city bus runs on the Spoke and Hub arrangement and runs mainly on the radiating routes of the city and concentrating in the city centre. Thus; making the city centre more chaotic for other vehicles and also increases travel time.

The accessibility modal evaluate longer travel time with comparatively less accessibility to outer areas. To overcome this deficiency and to cater the growing demand, a route was proposed based on population density, vehicles PCU count and Bus's PCU count and travel time. Also, it was studied from the inference that a inner circular route is also required to reduce travel time for shorter trip length.

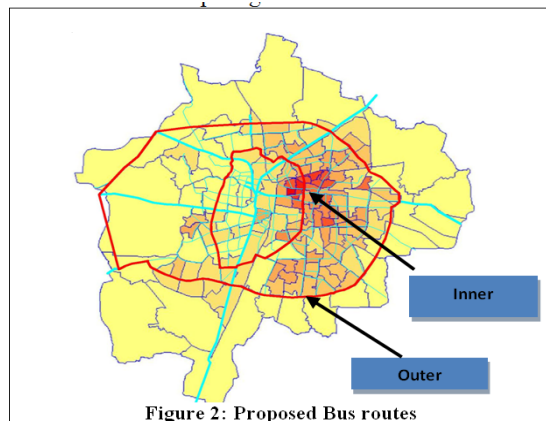


Figure 2: Proposed Bus routes

Fig. 2: Proposed Bus routes

A cumulative opportunity analysis was conducted to know the impact of new proposed routes on the city.

1. Impact Analysis: Travel time Factor

A comparative analysis was conducted to check the effectiveness of prevailing routes and the changes occurs after the new routes are introduced in the system. The following are the results of the analysis.

ExistingFig. Route

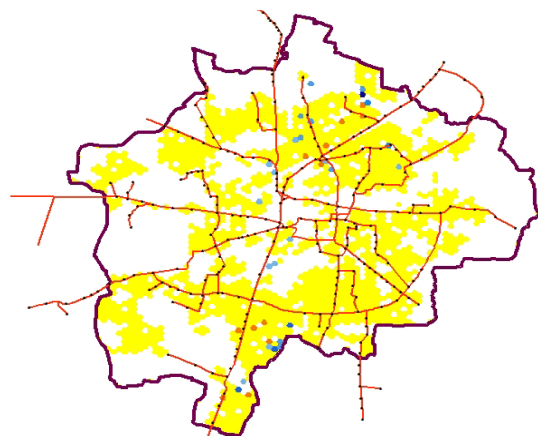


Fig. 3

Proposed Route

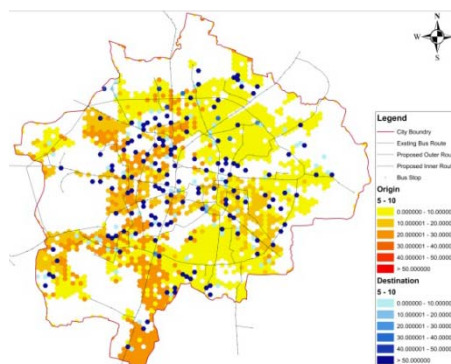


Fig. 3a

Fig. 3&3a: Comparative diagram showing accessibility from Origin to Destination in 5-10mins. travel time by Bus

Existing Route



Fig. 4

Proposed Route

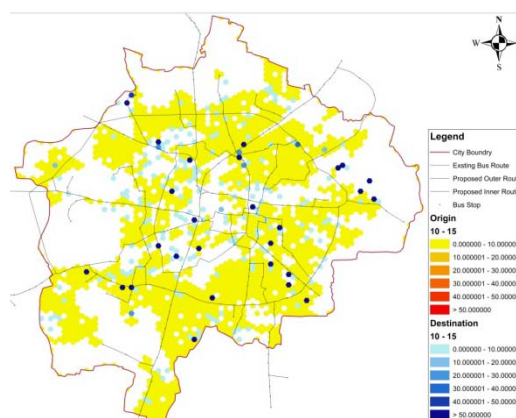


Fig. 4a

Fig. 4&4a: Comparative diagram showing accessibility from Origin to Destination in 10-15 mins. travel time by Bus

Existing RouteFig.

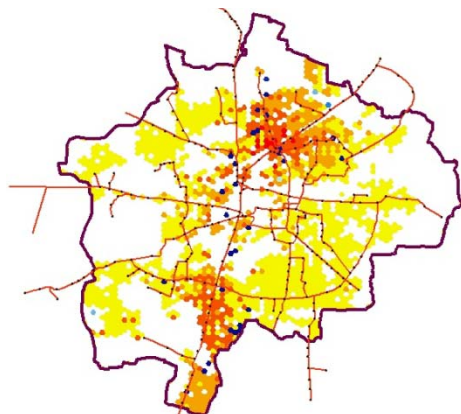


Fig. 5

Proposed Route

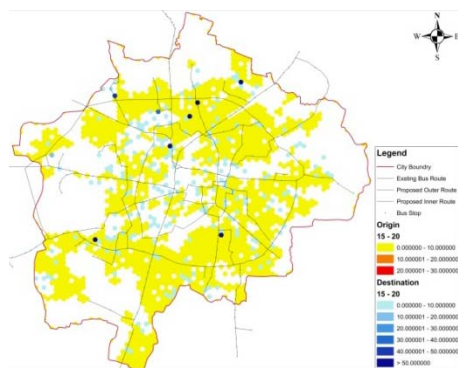


Fig. 5a

Fig. 5&5a: Comparative diagram showing accessibility from Origin to Destination in 15-20mins. travel time by Bus

5. CONCLUSION

For the study area, the cumulative opportunity analysis was used to measure the accessibility to job, works, recreation, shopping, education and also home.

The conclusion comprises of cluster formation of land use and overlapping the routes and frequency, the accessibility ratio was measured. The result came with the origin and destination as a separate entity describing it with the access to the transport facility and in accordance with the travel time. Fig. Fig.

5.1 For Origin (Residences)

In the comparative analysis, a strong connectivity is shown in trip generation. After introducing new routes, the bus service caters trip production and thus it makes a drastic difference in the system. By introducing the inner route, the origins are accessible in a very less time of about 5-10 minutes range.

This shows that the city is not having a wider sprawl and even the development is compact in nature and also the road network is efficient. North and South part of the city was already well connected with less travel time. But with the introduction of new routes, the western part of the city also gets less travel time of just 10 minutes. Most parts of the city get connected within a time range of 30 minutes compared to the existing situation the travel time has been considerably reduced and gets connected mostly in the time of 30 minutes.

5.2 For Destination (Activity locations)

The destinations are mainly encircled in the inner route hence, the destination become closer and accessible to the transit service. The destination was having a considerable difference, as now many areas get access in the travel time of just 10 minutes. The next 10 minutes connects the outer destination points. The outer route as was provided for making the commuters move in the outer periphery has also reduced the travel time and the areas are within the range of 30-35 minutes.

The result indicates the need of circular service in the core area which can cater the demand of the old city and also the radial routes while the outer route of the city indicates the through movement of the people to reach the desired destination without entering the city and reducing the travel time.

Thus; solution of providing circular route that can cater the demand of the radial routes on inner and outer area of the city results positive while making many areas accessible within 10 minutes distance. Even majority of the city was covered in the time range of 30 minutes. Thus, the proposal of making circular routes is justified with decrease in travel time.

6. INFERENCE

The objective of providing a well efficient public transport also requires scheduling of buses and frequency thus making any system more reliable especially at its start and stop time. Even the strategic location of Bus stops can make people accessible to service. Also, according to the flow of traffic on corridors, the frequency can be revised throughout the daytime. An integrated approach helps commuter to board public service with other modes used as a feeder system to the trunk system. In the old part of the city that have generally narrow lanes & spill out activities discourages buses; in such areas feeder service can be effectively worked out. Other facilities like Park and ride can also encourage public transport ridership.

Thus; accessibility is a very productive tool for understanding the land use and Transport integration. It enables people to use different methods of travel, their need or desire to participate in activities and time constraints. It also helps in understanding the deficiency in the service and methods to improve it. Accessibility is an analytical method to determine

the areas which are deprived of the transport services and suggestive measures to improve it. Accessibility deals with the individual's travel pattern, travel time and activity location, thus it provides with the real time solutions. For integrated approach of different modes, effective application of accessibility can improve the transit network throughout the region. The accessibility measure with proper formulation can also help in making political decisions like implementation of new modes, introduction of new route, even Fig. decision of installing stops/Stations or terminals.

Therefore, to make the city sustainable in regards of integrated approach, accessibility acts a major component to achieve it.

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