USE OF TRANSCAD IN BUS TRANSIT PLANNING: A CASE OF ANAND CITY

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ABSTRACT
Due to increase in urban population, there is a great increase in private vehicles which has lead the cities to the state of urbanization. Thus, due the increase in the private vehicles the cities are facing problems in terms of traffic congestion, accidents, increased travel time etc. Therefore it is very essential to provide effective public transport, i.e. bus transit. A study of the VTCOS Bus service is presented to evaluate the performance of this bus service. The study is carried out in the city of Anand, Gujarat, India. The study results are presented using GIS software, TransCAD. The data was collected as primary & secondary data. GIS for transportation is a very useful in the field of transportation planning. Here the main objective of the study is to determine the existing characteristics of the bus service and to provide and optimize the route of the bus service. The analysis showed that TransCAD happens to be an effective tool in bus transit planning.

KEY WORDS: Urbanization, GIS-T, Geo-referencing, TransCAD, VTCOS

INTRODUCTION
The development of cities in India has been substantial in the recent years. Thus it has led the country to the state of urbanization. Urban development has possessed a very serious issue to the transportation planners in India. Having these cities developed substantially, the economic growth of the city and wellbeing of the habitants is much influenced by the transportation systems of the city. Thus there is a greater need of proper public transport planning. As compared to private mode of transport, public transport i.e. Buses uses less space of road per person. Thus the road width can be adequately used and congestion can be minimized. It will reduce the number of vehicles on the road therefore traffic problems will also be reduced. Thus bus transport results in better road utilization and are favorable from system perspective.

GIS technology is a rapidly growing tool in transportation engineering. GIS (Geographical Information System) is a computer-based tool for mapping and analyzing spatial and non-spatial data. GIS technology integrates common database operations such as query and
statistical analysis with the unique visualization and geographic analysis benefits offered by maps. GIS is considered to be one of the most important new technologies, with the potential to revolutionize many aspects of society through increased ability to make decisions and solve problems. GIS is widely used for transportation planning & also known as GIS-T (GIS for Transportation).

TransCAD software is a revolutionary system for transportation data management and analysis. TransCAD fully integrates Geographical Information System (GIS) with planning, modeling and logistic operations (TransCAD 2000). It is ideal for highway network, transit routing and planning operations. TransCAD extends the traditional GIS model to include transportation data objectives such as:

- Transportation networks
- Shortest paths
- Matrices
- Routes and Route systems
- Linear referenced data

These extensions make TransCAD the best data management and analysis tool for working with transportation data. The use of GIS functions to prepare, visualize, analyze and present helps to represent the work. Application modules can be used to solve routing, logistics and other transportation problems with greater ease and efficiency. Network and matrices can be of virtually unlimited size.

**LITERATURE REVIEW**

In past, various studies have been conducted in the context of use of GIS in transportation planning. ASHISH VERMA & S. L. DHINGRA (2005) discussed a model for optimally aligning an urban rail transit system within an integrated framework, on a demand-oriented corridor on a city transport network, using geographical information system (GIS) tools. R. SHANKAR, J. KAVITHA & S. KARTHI (2003) presented the optimization of bus stops using GIS technique. The study was conducted in the city of Chennai, India. The results show that the bus stop location could be changed in some places. In few sites the bus stops were too closely located which results in unnecessary loss in time and space. Another solution obtained is the optimal location for the creation of new bus stop, that would serve the population that earlier suffered.
XIAOTANG (2009) studied comprehensive optimal bus trips plans for Wuhan city in China. Based on the bus route network model at the directional level this research develops an improved methodology to generate optimal transit routes. With the availability of the directional stops, it is possible to model the walking links between the stops.

MUKTI ADVANI studied Improvement in Transit Service using GIS in Bhavnagar city. The study was presented to obtain optimal routes from one origin to many destinations kind of problem, with an objective of minimizing travel distance and travel time of users. Constrains taken into consideration were impedance for intersections, type of road and speed.

MS. NIPA A. DESAI and B. D. VASHI studied Optimization and Privatization Of City Bus Network Using Gis. The study was conducted with a view to study present trend of intra-city transportation system of Vadodara city, to evaluate performance of existing Gujarat State Road Transport Corporation (GSRTC) bus service and to evaluate the present public transport system in terms of passenger demand. Moreover, it has been taken to study modal split and then prepare and suggest optimization of bus fleet so as to satisfy the needs of Vadodara city commuters and to make the bus service a profitable business.

STUDY AREA PROFILE
The study is conducted in the city of Anand, Gujarat, India. Anand is known as the Milk Capital of India. Anand is the administrative centre of Anand district in the state of Gujarat, India. It is administered by Anand Municipality. Anand is located at 22.57°N 72.93°E. It has an average elevation of 39 meters from mean sea level. City has area of 22.7 square kilometers. The location of Anand is given in fig. 1.

GUJARAT STATE INDIA

ANAND MAP

Fig. 1 Location of Anand city
METHODOLOGY & DATA COLLECTION

The study methodology adopted includes problem identification, setting goals and objective, collection of primary and secondary data for input to arrive at intended results as per objectives. The methodology is given in fig.2.

Collection of data base was done with the help of two types of data:

1) Spatial Data
2) Non-Spatial Data

Spatial database includes collection of the map of Anand city from the legal authorities. The legacy map of Anand city was collected from the nagarpalika of Anand. The map of
Anand was then converted into TIFF (Temporary Image File Format) image for digitization. Fig 3 shows the legacy map of Anand city prepared in TransCAD.

![Fig. 3 Existing road network for study area](image)

Non-spatial data is also called attribute data. It includes the basic information about the city and data such as total population of Anand city, ward wise population, city bus routes starting from Anand railway station. The non-spatial database consists of information about the trips of city bus and constitute following information for each route starting from Anand railway station in different directions: Origin, destination, no. of buses used for each route, total length of route in km. etc.

Boarding & alighting survey was done on all the routes of city bus service. VTCOS bus service runs on various 9 routes throughout Anand city & surrounding rural regions. The survey was carried out on each route of the bus service. A typical non-spatial data sheet is given in table-1. Another type of data was collected in terms of O-D survey of auto rickshaws. Survey was conducted with the help of 240 forms filled from passengers travelling in auto rickshaw. It was observed that auto rickshaws run parallel to the routes of VTCOS bus service, which affects the functioning of the bus service. O-D survey was conducted on various 6 stops of the city.
Table-1 Typical non-spatial data for each route of city bus

<table>
<thead>
<tr>
<th>Route ID</th>
<th>Actual Route No</th>
<th>Name of Route</th>
<th>Length Of Route(km)</th>
<th>Travel Time per Trip(min.)</th>
<th>No of Trips</th>
<th>No of Buses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>Mogri-Gana</td>
<td>10</td>
<td>25</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Vadtal</td>
<td>12</td>
<td>35</td>
<td>58</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Adas</td>
<td>12</td>
<td>30</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Bakrol</td>
<td>8</td>
<td>15</td>
<td>31</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>6A</td>
<td>GIDC-ADIT</td>
<td>7</td>
<td>30</td>
<td>27</td>
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<tr>
<td>6</td>
<td>6C</td>
<td>Valasan</td>
<td>12</td>
<td>35</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>6D</td>
<td>Bandhani</td>
<td>14</td>
<td>45</td>
<td>61</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Sandesar-Sinhol</td>
<td>14</td>
<td>30</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>Sarsa-Khambodaj</td>
<td>17</td>
<td>55</td>
<td>30</td>
<td>3</td>
</tr>
</tbody>
</table>

DATA ANALYSIS
The collected data was input in TransCAD for digitization. The scanned image of map was put into TransCAD to make attribute maps. First geo-referencing was done of the image with latitude and longitude of three points to register the image. Fig 4 shows the geo-referencing and fig 5 shows the city bus route and bus stops location.

![Fig 4 Geo-referencing](image1)
![Fig 5 City bus routes & bus stops location](image2)

With the data collected from boarding & alighting survey analysis is done to figure out characteristics of various routes. From the survey it was seen that route 10 & route 6D were the most used routes. Fig 6 shows the route 10 and fig 7 shows the analysis of the boarding and alighting survey. Fig 8 and Fig 9 shows the route 6D and the analysis of that route respectively.
Fig 6 Route 10

Fig 7 Analysis of route 10

Fig 8 Route 6D

Fig 9 Analysis of route 6D

Here, it is evident that the bus service runs effectively only on these two major roads. The main stations where the boarding of passengers were considerably high is shown in table-2 for both routes.

Table-2 Boarding & Alighting of passengers on Routes 10 & 6D

<table>
<thead>
<tr>
<th>Route no</th>
<th>Stops</th>
<th>Boarding</th>
<th>Alighting</th>
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</thead>
<tbody>
<tr>
<td>10</td>
<td>Mahendrashah</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>New bus stand</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Bhaikaka</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>6D</td>
<td>Borsad intersection</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Bandhani intersection</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

As seen from the analysis there are very few stops where the passengers were boarding & alighting the most. So for both the routes, the number of passengers where very low in between these consecutive major stops. So from the boarding & alighting survey the major stops where the passengers demand were high were selected and O-D survey was done for auto rickshaw passengers. The six stops where the survey was carried out are shown in figure 10.
Fig 10 O-D survey Stops
From obtained O-D matrix it was seen that the trips generated from stop 1 to 5 and 2 to 5 were considerably high. Thus we can see from the data analysis that there is no bus service running between stops 2 and 5 directly. Also the demand of passengers from 6 to 2 and 6 to 1 is also high.

Table 3 O-D Matrix for Auto-Rickshaw passenger

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
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<th>4</th>
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<th>6</th>
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<td></td>
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<tr>
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<td>14</td>
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<tr>
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<tr>
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<td>0</td>
<td>5</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>

CONCLUSION
From the data analysis it is seen that the VTCOS bus service is not running throughout the city of Anand. There some major roads and areas where the service is not available. As data obtained from the O-D survey, it can be seen that the trips generated from survey stops 2 to 5 and 1 to 5 are high and there is no direct service available in this route. So a suggestion can be made to provide a circular route between stops 1-2-5-6 as shown in fig 11. Analysis showed that along the other routes, auto rickshaws dominates the bus transit service. Bus service is also not available in between stops 3 and 4.
It is recommended to select large sample size and repeat study for more accurate results.

REFERENCES:
4. MUKTI ADVANI, “Improvement in Transit Service using GIS – Case study of Bhavnagar State Transport Depot”.