Bus Terminal Study for BEST

“A Methodology to Incorporate Infrastructure into Public Transport Planning in Constrained Urban Areas”

Under Supervision of
Priyanka Vasudevan
Senior Associate - Urban Transport
EMBARQ India

Presented by
Naresh Kuruba
Research Intern – Urban Transport
EMBARQ India
Structure of presentation

- Background
- Study area delineation
- Data collection
- Analysis and findings
- Plan and design of terminal
- Impact on operations and passengers
- Conclusions and recommendations
The success of public transport is largely depend on it’s **supportive infrastructure** such as terminals, depots, etc.

To understand the effects of infrastructure on bus operations and services, this study focus on **terminal infrastructure**

Terminal is a place where routes begin or end or both

There are logically located at point where many routes converge and/or diverge
Objectives

- To identify the **existing bus route network** in the study area
- To determine the **infrastructure gaps** in the network using planning tool such as GIS
- To estimates the **impact of a proposed terminal** on bus operations.
Methodology

Selection of planning area → Data collection

Identifying bus route network in the study area

Assessment of existing bus route network using GIS

B&A Surveys → Plot existing bus terminals

Analysis of existing situation

Identify terminal gaps in the study area

Options to incorporate terminal infrastructure → Plan and design of the terminals

Impact on operations suggested over the terminal

Objective: 1

Objective: 2

Objective: 3
Case Study: Island City, Mumbai

Area—67.7 sq. km  Population—31,45,966 (2011)
Pop. Density—46,470/sq.km
PT Share: 78%  Bus Share: 26%
Data Collection

- **Primary data collection**
  - Boarding & Alighting Survey Along Routes
  - Site visits

- **Secondary data collection**
  - BEST Bus Atlas as on Nov 2013
  - Details of Bus Terminals as on April 2013
BEST Bus Infrastructure in Mumbai’s Island City

- **Depots**: 7
- **On-street terminals**: 41
- **Off-street terminals**: 11
- **Fleet operated**: 960
- **Types of buses**
  - Single deck
  - Double deck
  - Midi
  - Mini and
  - Air condition
BEST Bus Operations in Mumbai’s Island City

- Total no. of routes: 135
- These routes are operates with various types of services

<table>
<thead>
<tr>
<th>Type of service</th>
<th>No. of routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary</td>
<td>102</td>
</tr>
<tr>
<td>Limited</td>
<td>25</td>
</tr>
<tr>
<td>Express/ corridor</td>
<td>5</td>
</tr>
<tr>
<td>Air-conditioned</td>
<td>3</td>
</tr>
</tbody>
</table>

- Avg. passengers per day: **8.5 lakh**
Identifying bus route network

Conceptual diagram

Buses generally have sufficient turning radii only on arterial and sub-arterial roads

Relationship between “road hierarchy and bus route”

Arterial road
Sub-arterial road
Collector road
Local road
Bus stop
Bus route

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Depot wise operational routes

- Backbay: 18 routes
- Colaba: 15 routes
- Central: 20 routes
- Wadala: 21 routes
- Worli: 16 routes
- Dharavi: 23 routes
- Pratiksha Nagar: 22 routes
## Summary of depot wise operational routes

<table>
<thead>
<tr>
<th>Name</th>
<th>Backbay</th>
<th>Colaba</th>
<th>Central</th>
<th>Wadala</th>
<th>Worli</th>
<th>Pratiksha Nagar</th>
<th>Dharavi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of routes</strong></td>
<td>18</td>
<td>15</td>
<td>20</td>
<td>21</td>
<td>16</td>
<td>23</td>
<td>22</td>
<td>135</td>
</tr>
<tr>
<td><strong>With-in city</strong></td>
<td>16 (94%)</td>
<td>8 (67%)</td>
<td>16 (80%)</td>
<td>10 (50%)</td>
<td>13 (81%)</td>
<td>10 (50%)</td>
<td>8 (38%)</td>
<td>89 (64%)</td>
</tr>
<tr>
<td><strong>Connected</strong></td>
<td>1 (6%)</td>
<td>4 (33%)</td>
<td>4 (20%)</td>
<td>10 (50%)</td>
<td>3 (19%)</td>
<td>10 (50%)</td>
<td>7 (33%)</td>
<td>31 (31%)</td>
</tr>
<tr>
<td><strong>Out-side city</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 (29%)</td>
</tr>
<tr>
<td><strong>Avg. no. of buses</strong></td>
<td>126</td>
<td>80</td>
<td>130</td>
<td>152</td>
<td>114</td>
<td>202</td>
<td>156</td>
<td>960</td>
</tr>
<tr>
<td><strong>Avg. vehicle utilization</strong></td>
<td>151</td>
<td>146</td>
<td>159</td>
<td>176</td>
<td>155</td>
<td>202</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td><strong>Avg. pax. per day in lacks</strong></td>
<td>1.14</td>
<td>0.72</td>
<td>1.22</td>
<td>1.05</td>
<td>1.09</td>
<td>1.67</td>
<td>1.42</td>
<td>8.5</td>
</tr>
</tbody>
</table>
# Analysis Outputs

<table>
<thead>
<tr>
<th>#</th>
<th>Analysis</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Route coverage</td>
<td>% area covered by public transport</td>
</tr>
<tr>
<td>2</td>
<td>Service frequencies</td>
<td>% of area covered by high frequency bus services</td>
</tr>
<tr>
<td>3</td>
<td>Terminal influence</td>
<td>Terminals gaps</td>
</tr>
<tr>
<td>4</td>
<td>Transit demand</td>
<td>Major activity nodes</td>
</tr>
</tbody>
</table>
## Route coverage area

<table>
<thead>
<tr>
<th>No.</th>
<th>Buffer in mts</th>
<th>% of coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100m</td>
<td>47.8%</td>
</tr>
<tr>
<td>2</td>
<td>200m</td>
<td>72.4%</td>
</tr>
<tr>
<td>3</td>
<td>300m</td>
<td>84.0%</td>
</tr>
<tr>
<td>4</td>
<td>400m</td>
<td>89.7%</td>
</tr>
<tr>
<td>5</td>
<td>500m</td>
<td><strong>93.2%</strong></td>
</tr>
</tbody>
</table>

- 500m is considered as desirable distance for walk
- **93%** of the Island area is within walkable distance
### Service Frequencies

<table>
<thead>
<tr>
<th>Frequency in min.</th>
<th>% routes</th>
<th>% coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 min</td>
<td>25.6%</td>
<td>74.9%</td>
</tr>
<tr>
<td>10-15 min</td>
<td>32.0%</td>
<td>88.7%</td>
</tr>
<tr>
<td>&gt;15 min</td>
<td>42.4%</td>
<td>93.1%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

➢ **75%** of the area is covered with high frequency bus service
Various influence zones are created to the existing terminals.

The area marked shows that lack of terminals in the study area.

**Dadar- Parel belt** is identified as a serious need of terminal infrastructure.
## Potential terminals points

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name</th>
<th>No. of routes</th>
<th>No. of buses/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dadar Plaza</td>
<td>25</td>
<td>104</td>
</tr>
<tr>
<td>2</td>
<td>Lower Parel</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>Prabhadevi</td>
<td>18</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>Parel (W)</td>
<td>24</td>
<td>102</td>
</tr>
<tr>
<td>5</td>
<td>Senapati Bapat Marg</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Nehru Planetarium</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td>7</td>
<td>Mahalakshmi Temple</td>
<td>16</td>
<td>73</td>
</tr>
<tr>
<td>8</td>
<td>Metro BIG Cinemas</td>
<td>13</td>
<td>64</td>
</tr>
<tr>
<td>9</td>
<td>Dockyard Marg</td>
<td>11</td>
<td>38</td>
</tr>
</tbody>
</table>

These terminal points are identified based on terminal influence gaps in the study area and where routes merge/diverge.
These terminals are identified based on “Details of Bus Terminals as on April 2013”.

Today, two points have on-street terminals out of nine points. Namely, Dockyard Marg and Nehru Planetarium.
Boarding and alighting survey (BAS)

Route No: **63**

**Chuna Bhatti To Vasantrao Naik Chowk**

- **Route span:** 15.5 kms
- **No. of stations:** 34
- **Running time:** 90 min
- **Journey speed:** 11.3 km/hr

**Total no. of Boarding’s/Alighting’s:** **236**
- It is a new commercial and business centre
- This area already riddled with high densities and limited space
- This is a challenge in innovating ways to provide terminal infrastructure
- The location was identified under Senapati Bapat Marg Flyover at Elphinstone
Plan & design a terminal place
Impact on Operations

**VKT per day: 1395**

- Round trip length: 31 km
- Rounds trips per day: 5

**VKT per day: 425**

- Round trip length: 17 km
- Rounds trips per day: 5

**VKT per day: 280**

- Round trip length: 14 km
- Rounds trips per day: 5

Splitting the route would save **690 vehicle kilometers per day**, while maintaining the same **headway**, number of trips and **fleet size**.
Impact on Passengers

VKT per day: 1395

Round trip length- 31 km
Rounds trips per day- 5

Headway- 13 min

VKT per day: 765

Round trip length- 17 km
Round trips per day- 9

Headway- 7 min

VKT per day: 616

Round trip length- 14 km
Round trips per day-11

Headway- 6 min

Bus
Terminal
Interchange
A Chunna Bhatti
B Vasantraonaik Chok
C Lower Parel
D Elphinstone

It is also observed that improving headway from **13 min** to **7 min** (Route A-C) and **6 min** (Route C-B), while maintaining the same fleet size and VKT.
Conclusions & Recommendations

- For the operator, the implementing terminals results savings in vehicle kilometers travelled (VKT) for existing services.
- For a passenger, an additional terminal can improve service reliability and frequency through the introduction of shorter routes.
- The study is recommended to improve the quality of transfer/interchange facilities.
- There is a need to plan, design and identify the impact of proposed terminals to maximize the operational efficiency.
Thank You!