BIKE AND RIDE:
INTEGRATING BICYCLES AND PUBLIC TRANSPORT

Under Guidance of
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Presented by
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Urban Transport Planning & Management
CEPT University
INTRODUCTION TO “BIKE & RIDE” (B&R)

ANALYSIS AND FINDINGS

CONCLUSIONS AND RECOMMENDATIONS
In case of Ahmedabad,

- Share of **bicycle trips** out of total trips has **declined** from 19% in 2001 to 14% in 2011.
- Share of **public transport trips** has **declined** from 30% in 2001 to 22% in 2011.
- Share of **private motorized trips** has **increasing** from 38% in 2001 to 42% in 2011.
- NUTP emphasized on **priority to public transport and non-motorized transport (NMT)**
Bus Rapid Transit System (BRTS) serves the mobility needs of the people. But, it is not designed to provide door-to-door connectivity. Access and egress are weakest links in public transport system.

Accessibility to public transport is important to maximizing its attractiveness. As, it recommended to have a feeder modes.

Hypothesis:

“Bike and Ride” can help to achieve shift of commuters from private vehicles to public transport.

RESEARCH OBJECTIVES

- To review the various components of integrating bicycles and public transport.
- To identify the factors affecting use of bicycle as an access mode
- To identify the potential demand for “Bike and Ride” (B&R) services
- To estimate the cost efficiency of the “B&R” system.
RESEARCH METHODOLOGY

- Research problem ↔ Research objectives
  - Components of integration
  - Factors affecting use of bicycle
  - Learnings

- Data Identification
  - Secondary data collection
  - Site selection criteria
    - Site selection
    - Zone delineation
    - Primary data collection

- Analysis & Findings
  - Cost efficiency of the system

Conclusions & Recommendations

Only daily commuter trips (workers and students) were captured during the survey.

The private mode users (two wheelers and four wheelers) were the target group for the survey.

Intra city trips were considered during the survey.

Research findings are based on bicycle owning households. Public bicycles and cycle rentals were not considered.

The travel cost is calculated based on the fuel prices and BRT fare during the time of research.
INTRODUCTION TO “BIKE AND RIDE” (B&R) SERVICES

- DEFINING “BIKE AND RIDE” (B&R)
- COMPONENTS OF INTEGRATION
- APPLICABILITY OF B&R SERVICES
- FACTORS AFFECTING USE OF BICYCLE MODE
"Bike and Ride" allows you to park your bicycle in a bicycle parking facility during the day and transfer to a bus for the rest of your trip. You pay a normal bus fare, with no additional charge to park your bicycle at a parking facility.

**Benefits of B&R:**

- Reduce vehicle kilometers travelled
- Reduce congestion
- Reduce energy consumption
- Reduce fatalities and injuries
- Improve air quality
- Co-benefits: health effects, more livable communities, etc.

*Source*

http://www.transport.act.gov.au/cycle_or_walk/bike_and_ride; WHO
Integrating bicycles and public transport consists of many links.

### COMPONENTS OF INTEGRATION

<table>
<thead>
<tr>
<th>Origin</th>
<th>Access trip</th>
<th>Access (The principles of bicycle routes are Consistency, Directness, Attractiveness, Road safety and Convenience)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>Transfers bicycle to public transport</td>
<td>(The principles of good bicycle parking facilities are Time, Cost, Service, Safety and Comfort)</td>
</tr>
<tr>
<td>Public transport ride</td>
<td>Public transport ride</td>
<td>(High quality public transport in terms of frequency, time, cost and also allowing bicycles on public transport during the trip)</td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer public transport to bicycle</td>
<td>(The facilities at destination transit stop would be Purchase &amp; store second bicycle (regular commuters), Bicycle rental services and Public bicycle services)</td>
</tr>
<tr>
<td>Egress</td>
<td>Egress trip</td>
<td>(The safe and fast passages and routes to important destinations as like access trip)</td>
</tr>
</tbody>
</table>

Source
APPLICABILITY OF “B&R” SERVICES

Applicability of Bike and Ride Services

Types of integration
1. Bicycle on bus
2. Bicycle to bus

Types of parking
- Cycle stands
- Cycle racks
- Cycle lockers
- Guarded cycle parking
- Automatic cycle parking

Ideal combinations
- Bicycle + Train
- Bicycle + Metro
- Bicycle + BRT
  - On longer distances

Station typology
- Terminal stations
- Interchange stations
- Intermediate stops

Combination of any one

Source
Factors affecting choice of bicycle mode for access to public transport

External Factors
- Built environment factors
  - Urban form
  - Infrastructure
  - Facilities at end destinations
- Natural environment factors
  - Landscape
  - Hilliness
  - Weather and Climate

Internal Factors
- Psychological factors
  - Perceptions
  - Attitudes
  - Habits
  - Social environments
- Socio-economic factors
  - Gender, age, income, vehicle ownership, etc.
- Travel factors
  - Travel cost
  - Travel time
  - Effort

Source
Site selection criteria

- Availability of public transit
- Station typology
- Residential land use
- Appropriate population density
- Appropriate worker & Student Population
- Appropriate income group people

Secondary data collection*

- Public transit system characteristics
- Land use
- Demography characteristics
- Socio-economic characteristics
- Bicycle ownership

Source

* Center of Excellence in Urban Transport, CEPT University; and Janmarg
Site Selection

- Residential land use
- Appropriate population density
- Appropriate worker population density
- Appropriate student population density
- Appropriate income
- Appropriate bicycle owning households

Source: Centre of Excellence in Urban Transport, CEPT University.
The acceptance of B&R is **high at the interchange station** followed by interchange cum terminal, terminal and intermediate stations.

**Source**: Household survey (2014)
STATION LOCATION

Source
b Study Area: **2.04 sq. kms** and Estimated Population: **56,790** (2006)

b **Major road network** leading towards selected station.

b Total four BRT routes are meeting at this station which is **well connected to all major employment and education destinations** like Narol, Naroda, Kalupur, L. D. College, etc.

b **0.5 km** distance is considered as walkable.

b Interval of 0.5 km upto 1.5 km has been taken for conducting household survey.

b In each zone **2% HH** were taken for collecting primary data

**Source** Centre of Excellence in Urban Transport, CEPT University (2006).
# Household Survey Details

<table>
<thead>
<tr>
<th>Particular</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of HH’s Surveyed</td>
<td>188</td>
</tr>
<tr>
<td>No. of Samples</td>
<td>309</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute value</th>
<th>Relative value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode share</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two wheelers</td>
<td>263</td>
<td>85%</td>
</tr>
<tr>
<td>Cars</td>
<td>46</td>
<td>15%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute value</th>
<th>Relative value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average trip length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two wheelers</td>
<td>5.7 kms</td>
<td></td>
</tr>
<tr>
<td>Cars</td>
<td>4.5 kms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute value</th>
<th>Relative value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average journey speed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two wheelers</td>
<td>23 km/hr</td>
<td></td>
</tr>
<tr>
<td>Cars</td>
<td>23 km/hr</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute value</th>
<th>Relative value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Willingness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two wheeler</td>
<td>36</td>
<td>12%</td>
</tr>
<tr>
<td>Car</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: Household survey (2014)
ANALYSIS AND RESULTS
APPROACH

Analysis

BRT Coverage at egress trip

Acceptance to B&R Characteristics

Economical travel Characteristics

- Bicycle ownership wise acceptance
- Income wise acceptance
- Travel distance wise acceptance
- Access distance wise acceptance

Travel distance

Travel time

Existing and Future BRT Network with its walkable (0.5 km) distance trips

Source

61% of trips out of total trips are within **walkable egress distance**

9% of willingness trips out of total trips are within **walkable egress distance**
This is a measure of the coverage of a bus route network. In an urban area, a walk of 500 meters or less
to or from the nearest bus stop is normally regarded as desirable: a distance greater than this is regarded
as inconvenient.
Naresh Kuruba, 4/23/2014
5.2% of the people are accepted for B&R services.

- Average income of acceptance is **10,937** per month.
- Average value of time of acceptance is **Rs. 54.68/hr.**

7.4% of the people are accepted for B&R services.

Source: Household survey
>4 km travel distance travelers are accepted for B&R services.

The average travel distance of acceptance is 7.5 kms.

Upto 1.25 km from the stations people are more willing to use B&R services.

Source: Household survey
The travel distance more than 4 km is economical to shift for B&R services.

It is calculated based on fuel price and BRT fare.

The travel distance more than 4 kms will loss <4 min.

It is calculated based on average speeds of different modes.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Average speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two wheeler</td>
<td>23 kmph</td>
</tr>
<tr>
<td>BRTS</td>
<td>26* kmph</td>
</tr>
<tr>
<td>Bicycle</td>
<td>12** kmph</td>
</tr>
<tr>
<td>Walk</td>
<td>3.5** kmph</td>
</tr>
</tbody>
</table>

Source
Centre of Excellence in Urban Transport, CEPT University.
### POTENTIAL MODE SHARE

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of commuters shift observed at Interchange station</td>
<td>791 (expanded)</td>
</tr>
<tr>
<td>Total no. of stations identified for “B&amp;R” facility</td>
<td>7</td>
</tr>
<tr>
<td>Total commuters shift to “B&amp;R” facilities</td>
<td>5537</td>
</tr>
<tr>
<td>Trips made by commuters per day</td>
<td>11074</td>
</tr>
<tr>
<td>Total Trips made by two wheelers per day</td>
<td>10,71,417 (26%)</td>
</tr>
<tr>
<td>% of shift from two wheelers to PT</td>
<td>1.03%</td>
</tr>
</tbody>
</table>

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**Source**

COST-BENEFIT ANALYSIS
## COST ESTIMATES

### CAPITAL COST

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land cost (in lakhs)</td>
<td>379.6</td>
</tr>
<tr>
<td>2</td>
<td>Total construction cost (in lakhs)</td>
<td>421.9</td>
</tr>
<tr>
<td>3</td>
<td>Total equipment’s cost (in lakhs)</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Junction improvements (in lakhs)</td>
<td>7.5</td>
</tr>
<tr>
<td>5</td>
<td>Other costs (in lakhs)</td>
<td>31.6</td>
</tr>
<tr>
<td></td>
<td><strong>Total capital cost in lakhs</strong></td>
<td><strong>850.8</strong></td>
</tr>
</tbody>
</table>

### OPERATION COST

- The operation costs includes, security staff requirements, administration requirements and other operations. The total cost requirements for **base year operations is 27.8 lakhs**. The **inflation (Wholesale price index) 6.5%** is applied every annum for the **period of 20 years**.

### MAINTENANCE COST

- Maintenance cost is basically considered as two types. 1. Annual maintenance and, 2. Regular maintenance. **Annual maintenance is assumed as 2% percentage of construction cost** per annum for the project and **periodic maintenance is assumed as 5% of construction** cost per every five years for the period of 20 years.

**Source**: Centre of Excellence in Urban Transport, CEPT University
The economic analysis is carried out for the period of **20 years** for development of the “B&R” system on the Sola Crossroad BRT station of Ahmedabad city. It is estimated that the **Economical Internal Rate of Return (EIRR) of the project is 20.1%**. It is clear that the project is **economically feasible with minimum EIRR %**, i.e., the minimum requirement of EIRR is 20%. Hence it is recommended for implementation from the perspective of economic consideration.

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**Source**
*http://tripp.iitd.ernet.in/publications/paper/safety/dnmrk01.PDF; Centre of Excellence in Urban Transport, CEPT University.*
**CONCLUSION**

- Priority of BRT stations
  - **Interchanges**
  - Terminals
  - Intermediate stations

- Total potential shift of commuters from two wheeler to B&R services is **1.03%**

- Economical travel distance is **>4 kms**

- Effective catchment area is upto **1.25 kms**

- Cost efficiency (EIRR) of the system within period of 20 years is **20.1%**
It is recommended to provide **public bicycles and/or rental bicycle** possibly to increase the potential demand for B&R facilities.

Make sure the **availability of bicycles**, whose point of **destination is too far** from the station.

Private vehicles are relatively costly to own but relatively cheap to use. So, it is recommended to have a policy to provide **incentives to the private vehicle users** to encourage the use of B&R services.

It is recommended to **identify the funding sources** for capital investment on bicycle infrastructure.

However, there is **no significant change in private mode share** due to implementation of B&R facilities other alternative modes should be explored.

Thank you...