III. Market Factors and Demand Analysis

Public Transport Planning and Regulation: An Introduction
# Planning and Analysis Building Blocks

## Schedule Building

- Measures & Standards
- Network and Route Design

## Cost Analysis and Financial Planning

- Performance Analysis
- Service Monitoring and Data Collection
- Fares and Revenue: Policy, Analysis, and Collection

## Market Factors and Demand Analysis

- Terminology and Basic Relationships

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**Focus of Discussion**
Market Factors

• The market for public transport (PT) is affected by a variety of factors

• No two cities or even neighborhoods are the same in terms of these factors

• Different combinations of factors generate the need for different types and levels of PT service
Factors Affecting Market for Public Transport

- Travel needs
- Land use
- Trip maker numbers and demographics
- PT service parameters
Why is It Important to Understand Market Factors?

- Helps in estimating PT ridership
  - Ridership is linked to public transport performance, revenue, financial sustainability
  - Ridership is a measure of benefits
- Essential for planning and design
- Facilitates performance analysis through peer comparisons
Travel Needs

• Purpose

• Time-of-Day

• Nature of origin/destination
Purpose Impacts PT Use

• Non-Work
  – Shopping, personal business, medical, recreational, religious
  – *Occasional* trips — 1-3 times/week
  – *Discretionary* trips means users can forgo them, change timing or combine them
  – People often travel as *group*, e.g., family

• Work/School trips
  – *Recurring* (e.g., 5 days/week)
  – *Not-discretionary*, more tightly scheduled
  – Workers/students travel as *individuals*
Time-of-Day

- **Peak** — Morning/Afternoon Commuting Hours
  - Higher demand/unit time
  - High percentage of work trips
  - More individual travel
  - *Choice* and *captive* riders

- **Off-Peak** — Midday, Evening, Weekend Hours
  - Lower demand
  - More non-work travel
  - More group travel
  - *Captive* riders
Time-of-Day Demand Affects Bus and Facility Utilization

- More peak, less off-peak service operated
- Inefficient use of buses and facilities
  - Low service hours/bus
  - Low passengers/bus
  - Unused capacity during off-peak periods
- There are strategies to address this problem
Some Areas Have “Flat” Demand

- Relatively constant service operated
  - e.g., Casablanca

- Efficient use of buses and facilities
  - High service hours/bus
  - High passengers/bus
  - Capacity efficiently used during all periods
Urumqi, China
2006 O/D Survey Results

Figure 2.9 Trip Time Distribution by Purpose
Origin/Destination Volumes

• PT works best where there are large, concentrated travel volumes between high intensity areas
  – To/from large, dense housing estates
  – To/from large commercial centers, e.g. downtowns or central business districts (CBD’s)

• PT works best when concentrations of origins and destinations are arranged linearly
Urumqi, China

Figure 3.1 Desire lines of public transport in Urumqi (2006)
Manila
EDSA Bus Users
Distance from Origin to Destination

• Extremely short trips (2 km) mostly made by walking
• Bicycles viable option up to 8-10 km
• Conventional bus trip lengths generally 5-10 km in developing cities
• Suburban rail trip length average over 10 km
Urumqi, China Trip Times
2006 O/D Survey

Figure 2.11 Trip length distribution for journey to work

Figure 2.12 Trip length distribution for journey to school
Land Use

- Intensity/Density
  - Residential (Origin)
  - Activity Center (Destination)
- Availability of safe, secure walking environment
Origin/Destination

- Public transport works best for trips between:
  - *High density, “walkable”* residential and
  - *High density “walkable”* non-residential areas (e.g., traditional central business districts)

- Traditional public transport does not serve well trips between:
  - *Low density* residential areas and
  - *Low density* employment areas
Land Use Variations in Manila
Land Use Variations Beijing
Important Demographic Characteristics

- Income
- Gender
- Age
- Labor force/student population
Income Is Most Important Demographic Factor

• Low Income
  – Affordability
    • A problem when fares > 10% to 20% of income
    • Concessionary fares sometimes help
  – Alternatives are walking, bicycling

• Medium Income
  – Affordability is 3% to 5% of income
  – Taxis, two-wheelers and sometimes autos are alternatives

• High Income
  – Autos are an alternative
Bogota Travel by Income Group

- Low Income: 100% Public Transport
- Medium Income: 60% Public Transport, 20% Non-Motorized, 10% Auto, 10% Others
- High Income: 70% Public Transport, 10% Non-Motorized, 10% Auto, 10% Others
Gender

- Men are a larger proportion of PT riders in developing (not developed) cities
  - Lower proportion of women working
  - Higher proportion of women on weekends when non-work trips increase
  - Religious rules

- Women’s safety/security concerns
  - Lighting at stops
  - To stop/from stop
Gender
Manila Edsa Bus Users

Weekday
- Male: 62.3%
- Female: 37.7%

Weekend
- Male: 59.4%
- Female: 40.6%
Age

• Majority of PT users between 16-40
  – Workers
  – Students

• Fewer older workers, students
  – They may have money for taxis and other forms of private transport

• More younger travelers on weekends
Age Profile
Manila Edsa Bus Users

Age

Weekday
Weekend

0%
5%
10%
15%
20%
25%

10-15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
70+

WORLD BANK

III-27
Public Transport System Factors

• Levels and quality of PT service
  – Travel times, reliability
  – Comfort, amenities

• PT Fares

• Availability of safe, secure non-motorized access

• If affordable, availability of other options
  – Shared ride taxis
  – Conventional 2-, 3- and 4-wheeled taxis
  – Private motor vehicles two and four wheelers
Levels and Quality of PT Service

• All travel time not the same
  – Waiting, transferring and walking time much more onerous

• Reliability may be more important than average travel time

• Crowding a key quality factor, particularly for:
  – Women
  – Older people
  – Higher income travelers with choices
Availability of Safe, Secure Non-Motorized Access

• Pedestrian access conditions
  – Sidewalk coverage and repair
  – Crossings

• Bicycle facilities
  – Bikeways
  – Bicycle parking
Safety and Traffic Management

• Availability *and management* of safe, secure access and waiting facilities are important determinant of PT use

• Why?
  – Pedestrians and bicycle users
    • Large % of traffic injuries and deaths
  – People going to/from or waiting for PT
    • Large % of non-motorized travel deaths
Passenger Information a Key Service Quality Parameter

• People need to be aware of options
  – Routing
  – Schedules
  – Fares
• Many trips are non-recurring, making PT use difficult
  – Non work
  – Visitors
  – Tourists
• A big issue in developing cities
Why is Demand Estimation Needed?

• Ridership critical planning and design parameter
  – Assess the passenger and revenue impacts of new services and facilities
  – Assess the passenger and revenue impacts of service changes
Demand Estimation Techniques for Short-Medium Term Service Changes

- **Similar routes method**
  - Apply existing service experience to a service change

- **Statistical models**
  - Develop formula relating existing demand to existing service parameters

- **Elasticity models**
  - Apply percent change to current ridership based on change in a fare or service parameter
Similar Routes

Method
Ridership on proposed service will reflect ridership on an existing service

Estimation
1. Select similar service based on (typical):
   - Population density
   - Generators served
   - Service design (e.g., intervals, span)
2. Adjust ridership for differences
   - Service levels
   - Rider potential
Example of Similar Routes

Problem

Estimate ridership for a new route that will provide bus service between La Source (an edge town) and Orleans.

Solution

1. Collect data for a similar route

<table>
<thead>
<tr>
<th></th>
<th>New Route</th>
<th>Route 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population/Square Kilometer</td>
<td>15000</td>
<td>17000</td>
</tr>
<tr>
<td>Daily Kilometers</td>
<td>1600</td>
<td>1800</td>
</tr>
<tr>
<td>Daily Passengers</td>
<td>?</td>
<td>3125</td>
</tr>
</tbody>
</table>
2. Calculate ridership rate for Route 12

\[
\text{Ridership rate} = \frac{\text{Daily passengers}}{\text{Daily kilometers}} \\
= \frac{3125}{1800} \\
= 1.74 \text{ passengers/KM}
\]

3. Calculate potential users for new route as a percent of Route 12 population density

\[
\text{Potential} \% = \frac{\text{Population density (New route)}}{\text{Population density (Route 12)}} \\
= \frac{15000}{17000} \\
= 88.2\%
\]
4. Estimate ridership rate for the new route

\[
\text{Ridership rate} = \text{Route 12 ridership rate} \times \text{Potential \%}
\]

\[
= 1.74 \text{ passengers/KM} \times 88.2\%
\]

\[
= 1.53 \text{ passengers/KM}
\]

5. Estimate daily ridership rate for the new route

\[
\text{Ridership rate} = \text{New route ridership rate} \times \text{daily kilometers}
\]

\[
= 1.53 \text{ passengers/KM} \times 1600 \text{ KM}
\]

\[
= 2448 \text{ passengers (or 2400)}
\]

\[
\approx
\]
Key Issues
Similar Routes Method

1. Identification of key differences between existing and new route

2. Approach used to adjust for differences
Statistical Models

Method
Based on ridership on existing routes and key service and demographic variables

\[ \text{Ridership} = B + A_1X_1 + A_2X_2 + ... + A_3X_3 \]

Estimation

1. Collect data on existing routes
   - Socioeconomic variables — e.g., income
   - Land use variables — e.g., population
   - Service variables — e.g., headway
   - Daily ridership
2. Statistically “calibrate” model, develop mathematical parameters
3. Apply model
Example of Linear Regression

Ridership

Population within 300 Meters of the Route
Elasticity Models

**Method**

Elasticity is the ratio of the percent change in ridership to the percent change in a transit service parameter (e.g., fares, service levels).
Summary

• Discussed factors that affect public transport demand

• Described simple demand estimation approaches.

• Remember, understanding the market factors that influence public transport use is critical to PT service planning