Activity Opportunities and Changing Travel Patterns: A case of Developing Nations

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Contents

• Pubic transport crowding (A case of Ahmedabad city)
  • Measuring crowding
  • Public perception of crowding
  • Cost of crowding
• Activity-travel behavior in Mumbai
  • Introduction
  • Research gaps
  • Research objectives
  • Preliminary findings for Mumbai
  • Ongoing work
• Regional travel behavior (A case of inter-regional trips in India)
  • Destination choice
  • Mode choice
Public transport crowding (A case of Ahmedabad city)

India

Gujarat

Ahmedabad

Population- 5.6 million
Area- 464.14 sq.km
Public transport systems and crowding

Legend
- BRT routes
- AMTS routes
- AMC wards
### Objective measures of crowding

<table>
<thead>
<tr>
<th>Country</th>
<th>Benchmark (standing pax/m²)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>4</td>
<td>(UITP 2009)</td>
</tr>
<tr>
<td>Australia</td>
<td>4</td>
<td>(Diec et al. 2010)</td>
</tr>
<tr>
<td>USA</td>
<td>5</td>
<td>(TRB 2006)</td>
</tr>
<tr>
<td>China</td>
<td>8</td>
<td>(AQSIQ 2004)</td>
</tr>
</tbody>
</table>

Average count- 4.31 standing pax/m² (4.54 for AMTS, 3.62 for BRTS)
Higher during morning peak
Crowding peak – 8.32 standing pax/m²
Subjective measures of crowding

- Average increase of 18.49%
- Some routes as high as 48%
- Perception dependent on time of day, no. of choices, type of service, personal characteristics
Generalized cost

Adapted from Haywood and Koning (2013)

Generalized Cost (comfort) = \( p_d i + w_t l i T_{\downarrow} m \)
Cost of crowding

Sketch by: Shubhadeep Sengupta

GC-AMTS (₹)

- GC-AMTS (₹)
- GC-BRTS (₹)

GC-BRTS (₹)

- GC-BRTS (₹)
Activity-travel behavior in Mumbai

Population- 12.5 million
Area- 603 sq.km

Maharashtra

Mumbai
Activity-travel behavior in Mumbai - An Introduction

Adapted from time-space prism developed by Hagerstrand (1970)
Travelling patterns in Mumbai: Descriptives

Income wise distribution of activity purposes

Data source- Baker et. al (2005)
Travelling patterns in Mumbai: Descriptives

Commute time (mins)

Zone 1: 80 mins < 5k, 20 mins 5k-7.5k, 20 mins 7.5k-10k, 20 mins 10k-20k, 20 mins >20k

Zone 2: 80 mins < 5k, 20 mins 5k-7.5k, 20 mins 7.5k-10k, 20 mins 10k-20k, 20 mins >20k

Zone 3: 80 mins < 5k, 20 mins 5k-7.5k, 20 mins 7.5k-10k, 20 mins 10k-20k, 20 mins >20k

Zone 4: 120 mins < 5k, 40 mins 5k-7.5k, 40 mins 7.5k-10k, 40 mins 10k-20k, 20 mins >20k

Zone 5: 80 mins < 5k, 40 mins 5k-7.5k, 40 mins 7.5k-10k, 20 mins 10k-20k, 20 mins >20k

Zone 6: 140 mins < 5k, 60 mins 5k-7.5k, 30 mins 7.5k-10k, 20 mins 10k-20k, 20 mins >20k

Data source: Baker et al. (2005)
Changing patterns

Data source: ITU (2014)
Potential effect on travel behavior

Time

Space

Use of a service which provides information

Orders grocery home

Stays connected online

Socioeconomic factors
HH size, relationships, gender, age, level of education, vehicle ownership, type of housing, marital status, type of occupation, HH/individual income.

Spatial factors
Access to job, amenities (such as school, hospital etc.). Distance to job centre, jobs to population ratio.

ICT use
Use of smartphones, internet connectivity, types of ICT based services used, in-home and out of home ICT use.

Low capability

Change of spatial structure
Research gaps & Ideation

Socio-economic Parameters
- HH size, relationships, gender, age, level of education, vehicle ownership, type of housing, marital status, type of occupation, HH/individual income.

Mandatory Activities like work, school etc.

Maintenance Activities like daily shopping, health etc.

Discretionary activities like leisure etc. (including social trips)

Travel time, mode of travel, multiple use of time, travel time ratio, cost of travel, comfort, in-home time spent, substitution, complementarity, or modification.

Spatial parameters
- Access to job, amenities (such as school, hospital etc.), and public transport modes.
- Distance to job centre, jobs to population ratio, neighborhood density, land rent, house rent, wage paid by business firms, no. of sub-centres etc.

ICT use
- Use of smartphones, internet connectivity, types of ICT based services used, in-home and out of home ICT use.
Research Objectives

For a society with existing disparity, travel contributes to productivity and individuals aren’t just looking to reduce travel but are looking for better access to different opportunities. In such a scenario, the effects of different endogenous and exogenous variables (pertaining to spatial change and ICT use) on travel will vary based on the purpose of activities and the socio-economic characteristics of individuals.

a) To identify network factors which affect residential choice at a local level in developing nations taking the case study of Mumbai.

b) To evaluate the importance of travel time savings for different socio-economic groups.

c) Comprehensively model travel behavior adopting both spatial parameters and parameters related to ICT use, along with socio-economic, individual and household parameters.

d) To identify the change in time uses for different cohorts (e.g. age, gender etc.) based on the above mentioned parameters.

e) To evaluate the concept of value of access in context of a developing country like India, succinctly identifying the parameters that can improve access to opportunities for a larger section of society.

f) To suggest policy recommendations related to spatial change and ICT use, which can improve the overall access to activity opportunities in a city.
Real estate pricing and transport network

Effect of transport network characteristics on real estate prices - Results

<table>
<thead>
<tr>
<th>Model parameters</th>
<th>Residential</th>
<th>Commercial</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to nearest parking</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Distance to nearest bus station</td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
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<tr>
<td>Distance to nearest taxi stand</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
<tr>
<td>Distance to nearest school</td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
<tr>
<td>Distance to nearest mall</td>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
<td><img src="image15.png" alt="Image" /></td>
</tr>
<tr>
<td>Distance to nearest business node</td>
<td><img src="image16.png" alt="Image" /></td>
<td><img src="image17.png" alt="Image" /></td>
<td><img src="image18.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Red color imply negative association
Effect of transport network characteristics on real estate prices- Concluding discussions

- Real estate market is influenced by speculation, which is largely a local phenomenon.
- Distance to train stations negatively influenced residential property prices at Bandra-Kurla complex and distance to bus stops had a severe negative impact on housing prices in Dharavi, Dadar and Andheri.
- Distance to schools also have negatively influenced both residential and office property prices, while the distance to shopping malls and business districts have emerged as a significant factor in estimating property prices for all different types land use.
- A strong correlation between office and residential prices hint towards the willingness of people to stay near their workplaces.
Travel time savings or the value of access- case study of Mumbai- Concept

When people are less capable to enjoy “beings and doings” which add value to life, then people attach more importance to the production aspects of travel, and gradually put more value on the consumption aspects of travel with the increase in their capability.

1. Travel time is significantly related to individual capability and is lower for less capable
2. The variance of travel time, indicating the degree of freedom of movement, has positive association with individual capability

Travel time savings or the value of access-case study of Mumbai: Study area and data collection

<table>
<thead>
<tr>
<th>Type of housing</th>
<th>Individuals</th>
<th>Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIG</td>
<td>48</td>
<td>22</td>
</tr>
<tr>
<td>Slum</td>
<td>58</td>
<td>23</td>
</tr>
<tr>
<td>SRA</td>
<td>52</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>73</td>
</tr>
</tbody>
</table>
Travel time savings or the value of access-case study of Mumbai: Results and discussion

The mean capability and travel time of individuals from MIG housing was found to be significantly higher than those of Slum and SRA.

- The variance in travel time increased with the capability of the individual.
- Individuals with higher capability had the ability to spend more time to discretionary activities, whereas people in the lower order of capability were constrained to spend more time in mandatory activities.
- MIG have more flexible mode choices whereas other groups rely more on walking.
- Travel time savings would substantially underestimate the benefit of the infrastructure investment.
- Exploring the concept of value of access w.r.t. spatial policies and ICT use
On going work

Smart phone/Internet use vs housing type

- MIG
- SRA
- Slum

Smart phone/Internet use vs gender

- Male
- Female
On going work

### Type of services used

- Transport information
- Games
- Cab services
- Social networking apps
- E-shopping
- Online ticketing

### Time use while traveling

- Talking to other passengers
- Working
- Eating
- Playing games
- Sleeping
- Window gazing
- Gets bored
- Uses internet
- Listening to music
- Reading
Inter-region travel in India- Destination choice

Upsurge in economic activities
Polarisation of facilities in urban areas
Migration
Regional disparity
Satisfaction enhancement
Gaps in infrastructure

leading to pilgrimage trips
increased social trips
Trips due to healthcare & other needs

“to analyse regional travel patterns in India by studying social, health, and pilgrimage trips”

This might be significant to
(1) Better understand travel with respect to the existing disparity in infrastructure provisioning and economic opportunities
(2) Analyse the purpose that prompted the travel activity,
(3) Characteristics of the trips based on mode used, duration of the trip and spatial location of the destination, and
(4) Policy implications related to long distance travel

Is there any significant difference in travel patterns with respect to ‘within district’, ‘outside district but within state’ & ‘beyond district’?

On what factors do long distance travel depend in India?

“Clustering of opportunities/infrastructure might hold the key to longer distance trips in India”
Research methodology

NSS data on domestic tourism

- MNL models
  - Outcome variable: Trip destination
    - MNL for overnight trips
    - MNL for same day trips

ESDA for social, health & pilgrimage trips
  - Unit of analysis: District
  - Local Moran’s I in the type of trips viz. Social, health and pilgrimage trips.

Policy implications, discussions and future scope
O/N trips (Findings)

Destination within the district
- Number of HH members in the trip (-)
- Number of places visited (+)
- Mode: Bus(+), Train (+), Own (+)
- Time of year: July to Sept (-)
- Purpose: Social (-), Health(-), Pilgrimage (+)
- Type of stay: Hotel (+), Friends (-)

Destination outside the district but within the state
- Number of HH members in the trip (-)
- Number of places visited (+)
- Mode: Bus(+), Train (+), Own (+)
- Time of year: July to Sept (-)
- Purpose: Social (-), Health(-), Pilgrimage (+)

Destination outside the state but within the country
- Number of HH members in the trip (-)
- Number of places visited (+)
- Mode: Bus(+), Train (+)
- Time of year: April to June (-), July to Sept (-)
- Purpose: Social (-), Health(-), Pilgrimage (+)
Sameday trips (Findings)

Destination outside the district but within the state
Number of HH members in the trip (+)
Number of places visited (+)
Mode: Bus (+), Train (+), Own (+)
Time of year: July to Sept (-)
Purpose: - Social (+), Pilgrimage (+)
Type of stay: Hotel (+), Friends (+)

Destination outside the state but within the country
Number of HH members in the trip (+)
Number of places visited (+)
Mode: Train (+), Own (-)
Purpose: Social (-), Pilgrimage (+)

Healthcare trips
Clustering and Spatial Autocorrelation

<table>
<thead>
<tr>
<th></th>
<th>overnight trips</th>
<th>sameday trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>within state</td>
<td>I= 0.297</td>
<td>I= 0.338</td>
</tr>
<tr>
<td>outside state</td>
<td>I= 0.147</td>
<td>I= 0.158</td>
</tr>
</tbody>
</table>

Social trips

<table>
<thead>
<tr>
<th></th>
<th>overnight trips</th>
<th>sameday trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>within state</td>
<td>I= 0.2617</td>
<td>I= 0.142</td>
</tr>
<tr>
<td>outside state</td>
<td>I= 0.207</td>
<td>I= 0.082</td>
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</tbody>
</table>

Pilgrimage trips

<table>
<thead>
<tr>
<th></th>
<th>overnight trips</th>
<th>sameday trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>within state</td>
<td>I= 0.01923</td>
<td>I= 0.059</td>
</tr>
<tr>
<td>outside state</td>
<td>I= 0.0596</td>
<td>I= 0.059</td>
</tr>
</tbody>
</table>

Health trips
Discussions

• Lack of employment opportunities and other allied services such as education, force people from rural areas to migrate to urban areas.

• Current healthcare planning in India hierarchically allocates healthcare facilities based on certain population thresholds, which creates a lopsided distribution of sophisticated health centres in urban areas.

• Study provides the basis for travel induced infrastructure delivery planning. Transport policies reducing impedances towards social and pilgrimage activities, while provisioning of infrastructure to reduce the need for travelling for health activities can subsequently lead to the improvement of quality of life.
ありがとうございます

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