UNESCAP Capacity Building Workshop, Colombo
Integrated Land use and Urban Transport Planning: Principles and Practices

31st October 2017

Prof. Sanjay Gupta, Ph. D
Head, Transport Planning Department
School of Planning and Architecture
(an institute of National Importance by Act of Parliament)
New Delhi, India
Land Use – Transport Relationship

- Traffic is function of land use

- Improved Transport Supply
- Increased Accessibility
- Increased Land Value
- Land Use Change
- Increased traffic Generation
- Deterioration in Level of Services
- Increased traffic Conflict

Land use – Transport Cycle

10/31/2017   Prof. Sanjay Gupta SPA
Transport, Urban Form and Spatial Structure

Source: Literature Review
Vehicle Density vs Urbanized density

Source: Literature Review

- Urbanized density: key factor for car ownership rate!
- Importance of urban form!

\[ y = -177.06 \ln(x) + 1111.2 \]

\[ R^2 = 0.7643 \]
Relationship between urban form and cost-effective public transit

Source: Bertaud and Malpezzi 2003.
Note: Density of cities is represented by the actual scale; the representation of polycentricity or dispersion is experience based.
<table>
<thead>
<tr>
<th>City Parameters</th>
<th>Hyderabad</th>
<th>Bangalore</th>
<th>Ahmedabad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density (Urban Built in Persons/Sq.km)</td>
<td>10,526</td>
<td>9,378</td>
<td>17,441</td>
</tr>
<tr>
<td>Population Density (Urban Sprawl in Persons/Sq.km)</td>
<td>6,265</td>
<td>5,869</td>
<td>15,574</td>
</tr>
<tr>
<td>Compactness Index</td>
<td>0.60</td>
<td>0.63</td>
<td>0.90</td>
</tr>
<tr>
<td>Arterial Road Density</td>
<td>1.47</td>
<td>1.40</td>
<td>1.85</td>
</tr>
<tr>
<td>Public Transport Use</td>
<td>48%</td>
<td>51%</td>
<td>24%</td>
</tr>
<tr>
<td>NMV Use</td>
<td>21%</td>
<td>24%</td>
<td>32%</td>
</tr>
<tr>
<td>Trip Length (Total) km</td>
<td>10.5</td>
<td>11</td>
<td>5.7</td>
</tr>
<tr>
<td>Vehicle km/capita</td>
<td>10.81</td>
<td>8.90</td>
<td>6.4</td>
</tr>
<tr>
<td>Road fatalities per</td>
<td>518</td>
<td>865</td>
<td>263</td>
</tr>
<tr>
<td>Population (Million)</td>
<td>8.5</td>
<td>8.5</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Source: S. Swamy, CEPT

Prof. Sanjay Gupta SPA 10/31/2017
Population Decentralization: possible spatial patterns

- Car-oriented sprawl → Undesirable!
- Public-transport oriented poly-centric form → Desirable!
  Or Transit corridor with weak centers

Low density dispersion

Mono-centric

Poly-centric decentralization

Source: Literature Review
Smart Growth

Defined as a policy framework that promotes an urban development pattern characterized by high population density, walkable and cycle-able neighborhoods, preserved green spaces, mixed-use development, available mass transit, and limited road construction.

### Smart Growth Measures impacting Mobility

<table>
<thead>
<tr>
<th>Compact Development</th>
<th>Mixed use</th>
<th>Walking and Cycling conditions</th>
<th>Traffic Calming Design</th>
<th>Transit quality and accessibility (TOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces vehicle ownership and travel, increases use of alternative modes.</td>
<td>Reduce vehicle travel and increase use of alternative modes, particularly walking.</td>
<td>Reduce vehicle travel and increases non-motorized travel</td>
<td>Increase use of alternative modes. reduces VMT and increases non-motorized travel</td>
<td>Residents of TOD tend to own 20-60% fewer vehicles, drive 20-40% fewer miles, and use alternative modes 2-10 times more than in automobile-oriented areas.</td>
</tr>
</tbody>
</table>
Characteristics of Transit Oriented Development (TOD)

1. Compact, higher density development
2. Mixed uses
3. Good pedestrian environment
4. Public amenities
5. Parking management
6. Good transit service
7. Strong connectivity between transit and development

<table>
<thead>
<tr>
<th>Land Use Prototypes for TOD</th>
<th>Neighbourhood</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>10 – 15 %</td>
<td>5 – 15 %</td>
</tr>
<tr>
<td>Core/ Empl.</td>
<td>10 – 40 %</td>
<td>30 – 70 %</td>
</tr>
<tr>
<td>Housing</td>
<td>50 – 80 %</td>
<td>20 – 60 %</td>
</tr>
</tbody>
</table>

Source: Images from internet
Prof. Sanjay Gupta SPA
10/31/2017
Elements of TOD

Design—Walkable, pedestrian friendly

Diversity—Mixed use, places and activities

Place Making
Benefits of TOD

- Reduces sprawl
- Provide mobility choices
- Increase public safety
- Increase transit ridership
- Reduce rates of vehicle miles traveled
- Increase households’ disposable income.
- Reduce air pollution and energy consumption rates
- Improves real estate opportunities
GLOBAL CASE CITIES
Evolution of Copenhagen’s “transit first” plan

- Rail infrastructure was built, often in advance of demand, to steer growth along desired growth axes.
- The evolution of Copenhagen- from a finger plan to a directed rail-investment program along defined growth axes to a finger-like urbanization patterns

Source: Cervero 1998; reproduced with permission from Island Press, Washington, DC.
Integration of Transport with Housing in Singapore

Road and rail network connects the developments around the island

Source: Presentation of Mohinder Singh, LTA
Implementation of BRTS system with integration of land use, City congestion levels were reduced.

Source: City Transformation, 2013
TOD – International Best Practices

Colombia TOD NAMA

Curitiba Trinary Structural Axis

Hong Kong
Station Area Planning and Podium Development

Singapore Regional Vision

Prof. Sanjay Gupta SPA
10/31/2017
Curitiba

Integrating transit with land developments
Transit Oriented Development along BRTS corridor in Curitiba
An example of an “Rail + Property” (R+P) project that has yielded both high rates of financial returns and high ridership (and thus fare-box income) is Maritime Square at the Tsing Yi Station.
Glimpses of Transit Oriented Development across the World

- High densities around transit stations (Curitiba)
- Mixed land use (Stockholm)
- Pedestrian friendly and walkable neighborhoods (Stockholm, Hong Kong)
- Provides multiple transportation choices by multimodal integration (Singapore)
- Implement policy & strategies for land value capture (Singapore - Authority generated fund by selling development rights under the Government Land Sales (GLS))
EFFORTS IN INDIAN CITIES

10/31/2017  Prof. Sanjay Gupta SPA
Influence Zone Policy for Transit Oriented Development

GIS Data Source: GSDL (2010 Survey), DMRC

Note:
1. Map shows TOD catchments for DMRC Phase I, II & III. Phase III DMRC metro station locations are tentative.
2. TOD catchment zones exclude Special Areas designated in MPD.
3. Intense zone at interchange stations between two metro stations or metro and railway station extends upto 800 m from the stations catchment.

Source: UTTIPEC Policy and Guidelines
<table>
<thead>
<tr>
<th>Intense Zone</th>
<th>Standard Zone</th>
<th>NMT Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demarcation of Zone based on Station Type</td>
<td>Demarcation of Zone based on Station Type</td>
<td>Demarcation of Zone based on Station Type</td>
</tr>
<tr>
<td>• 300 M distance from centre of station.</td>
<td>• 800m* or 10-min walking distance of all MRTS Stations.</td>
<td>• 2000m** or 10-minute cycling distance influence zone of all MRTS Stations.</td>
</tr>
<tr>
<td>• 800m* or 10-min walking distance of Regional Interchange Station (i.e. two MRTS lines.)</td>
<td>• 800m* or 10-min walking distance of all MRTS Stations.</td>
<td>• 300 M influence zone of BRT corridors.</td>
</tr>
<tr>
<td>Major Planning Characteristics</td>
<td>Major Planning Characteristics</td>
<td>Major Planning Characteristics</td>
</tr>
<tr>
<td>• Pedestrian and NMT priority zone.</td>
<td>• High density mixed-use development.</td>
<td>• Equitable distribution of road space.</td>
</tr>
<tr>
<td>• Parking Supply restrictions.</td>
<td>• Equitable distribution of road space.</td>
<td>• Dense street network.</td>
</tr>
<tr>
<td>• All Standard Zone characteristics.</td>
<td>• Dense street network.</td>
<td>Zones within Intense or Standard TOD Zones which are not permitted for redevelopment.</td>
</tr>
<tr>
<td>Application Criteria for Influence Zone (TOD) norms.</td>
<td>All norms apply.</td>
<td>All norms apply.</td>
</tr>
</tbody>
</table>

Legend:
- **: Significant
- *: Major
- ***: Critical
Kadkurduma TOD Pilot Project by Delhi Development Authority

**Salient TOD features of the project include:**

1. Finer Network/hierarchy of streets incorporating all modes, ensuring pedestrian comfort and safety.
2. Shared ‘Park and Walk’ facilities.
3. Designed Shared streets
4. Multi-use and shared open spaces
5. Mixed use mixed income development
6. Built to edge buildings with transparency and active edges-for safety through eyes on the street.

<table>
<thead>
<tr>
<th>Business As Usual MPD</th>
<th>Densification by MPD-2012</th>
<th>Densification by TOD Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density – 270 pph</td>
<td>Density – 1242 pph</td>
<td>Density – 830 pph</td>
</tr>
<tr>
<td>Usable Open Space – 15%</td>
<td>Usable Open Space – 30%</td>
<td>Usable Open Space – 20%</td>
</tr>
<tr>
<td>Ground Coverage – 15%</td>
<td>Ground Coverage – 20%</td>
<td>Ground Coverage – 35%</td>
</tr>
</tbody>
</table>
PROPOSAL SUBMITTED
BRTS Land Development along BRT Corridor in Ahmedabad

- Densification started along BRTS corridors in 2006.
- Proposal to increase FSI along BRTS corridors to 2.4 or higher.
- Buffer of 250-300m from BRTS corridors.

Source: Prof. Swamy (CEPT)
TOD along BRTS Corridor in Ahmedabad

- Proposed Local Area Plans for the overlay zones
- Differential FSI - high in CBD area, along Sabarmati riverfront and transit corridor
- Removed height restrictions
- Increased ground coverage from existing 30% to 51%
- Premium FSI for energy efficient buildings
- Mandatory water harvesting, waste water reuse and solar energy for plot areas > 5000 sqm

Source: Prof. Swamy (CEPT)

10/31/2017 Prof. Sanjay Gupta SPA
TOD Development in Ahmedabad

Source: Prof. Swamy (CEPT)
Naya Raipur - Comparative Indicators

Original Design

Proposed Design

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Original Design</th>
<th>Proposed Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit station adjacent density</td>
<td>100 ppH</td>
<td>600 ppH</td>
</tr>
<tr>
<td>Transit corridor density</td>
<td>300 ppH</td>
<td>500 ppH</td>
</tr>
<tr>
<td>Transit adjacent mixed use</td>
<td>20%</td>
<td>50%</td>
</tr>
<tr>
<td>5 min walk distance to transit stop</td>
<td>30% population</td>
<td>50% population</td>
</tr>
<tr>
<td>Walk trip distance to amenities</td>
<td>5 to 10 mins</td>
<td>2 to 5 mins</td>
</tr>
<tr>
<td>Hierarchy of greens</td>
<td>Centrally concentrated</td>
<td>Well distributed</td>
</tr>
<tr>
<td>Natural features and contour conservation</td>
<td>50%</td>
<td>80%</td>
</tr>
<tr>
<td>Population accommodated in sector</td>
<td>11,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Connectivity across quadrants</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Legibility of urban form</td>
<td>Poor</td>
<td>Good</td>
</tr>
</tbody>
</table>
High Access Corridors as TOD: Case of Dholera along DMIC, India

High Access corridors:
- Located at about 250m to 750m (5 to 10 minutes walk) from the major public transit routes.
- Higher FARs and residential densities and greater mix of activities.
- Acts as major public transit route.
- Contains highest residential densities.
- Retail, service oriented activities for the surrounding populace, high density housing for workers in the industrial zones.

Source: Master Plan for Dholera
Transit and Walkability in Dholera

Creation of neighborhoods and walkable places connected by transit

10 min walking distance

Proposed BRT in Phase I and...

LRT In the later phases

10/31/2017 Prof. Sanjay Gupta SPA
How big will the city grow in future?

How much to densify: Density Versus Investment

**Case of Ahmedabad**

- INR 2000 Crores/yr
  - Density: 150 persons/ha
  - Area: 666 sqkm

- INR 3000 Crores/yr
  - Density: 125 persons/ha
  - Area: 800 sqkm

- INR 4500 Crores/yr
  - Density: 100 persons/ha
  - Area: 1000 sqkm

- INR 6075 Crores/yr
  - Density: 75 persons/ha
  - Area: 1333 sqkm

Projected Population of 1.25 Cr for greater Ahmedabad Region by 2031
Strategies to Promote Development around Stations - Global Practices

- **Station area planning**, including zoning, public improvements, development financing packages, and marketing programs.
- **Pedestrian-friendly infrastructure**, including pedestrian amenities as well as improved connections to transit, offices, retail centers, and homes.
- **Parking management and shared parking**, including parking “caps,” reduced parking requirements for new construction, and shared parking structures.
- **Local transit service**, including neighborhood access routes, feeder route systems,
Bicycle Access
- Bike networks should be connected with stations, marked with signage, and free of any barriers such as curbs and fences.

Taxi, Pick Up and Drop-Off Zones
- Taxi and pick-up/drop off areas should be signed, well-lit, close to and visible from the station entrance.

Using Pavement Efficiently
- The presence of street parking can also help to buffer pedestrians from fast moving vehicles and enhance the walkability of the area.

- Providing Station Area Access
Factors that Support TOD

- Competitive station area;
- Vacant/re-developable land available;
- Large parcels in single ownership or easily assembled.

- Strong market conditions;
- Commitment to transit;
- Strong and respected local leadership;
- Supportive policies and tools.
Key elements of Land use Transit Integration

- Enabling urban structure
- Complete Network & streets
- Public Transit & its strategic alignment
- TOD & Value capture
- Accessibility improvements in terms of local area plans
- Re-development & Re-vitalization & Transit
- Integrated Multimodal Transit Interchanges
Plan + Design Principles of TOD

1. Multimodal Integration
2. First & Last Mile Connectivity
3. Interconnected Street Network
4. Complete Streets
5. NMT Network
6. Traffic Calming
Plan + Design Principles of TOD

1. Mix Land Uses
2. Optimize Densities
3. Street Oriented Building
4. Manage Parking
5. Informal Sector
6. Housing Diversity
Components of Sustainable TOD

1. High-quality public transit
2. Non-motorized
3. Management of vehicles and parking
4. Mixed-use of space
5. Active ground floors and street fronts
6. Active and safe public spaces
7. Community involvement and safety

Source: TOD Guide for Urban Communities (EMBARQ)

10/31/2017
Prof. Sanjay Gupta SPA
Scales of Sustainable TOD

- **Urban Scale**
- **Inter Neighbourhood Scale**
- **Neighbourhood scale**
- **Road scale**

- Neighborhoods are defined, for this Guide, as the area encompassed by a 600 meter pedestrian and cycling radius (which corresponds to a 10-minute walk).
- To establish the intervention area, the neighborhood center or the public transit station should be considered as the start of the pedestrian and cycling radius.

Source : TOD Guide for Urban Communities (EMBARQ)
Quality Public Transport

Proximity to the urban footprint
Viability of public transit

Access to public transit
Public transit infrastructure

Source: TOD Guide for Urban Communities (EMBARQ)

10/31/2017
Prof. Sanjay Gupta SPA
Non-motorized Mobility

Continuity of the road layout

Internal connectivity

Pedestrian and cycling networks

Sidewalks and bike paths

Source: TOD Guide for Urban Communities (EMBARQ)

Prof. Sanjay Gupta SPA
Vehicle Demand Management

- Optimization of daily commutes
- Safe and orderly roads
- Parking management
- Road safety

Source: TOD Guide for Urban Communities (EMBARQ)
Mixed-use and Efficient Buildings

Regional facilities

Neighborhood facilities and retail

Efficient buildings

Pedestrian-street interaction

Source: TOD Guide for Urban Communities (EMBARQ)

Prof. Sanjay Gupta SPA
Neighborhood centers and active ground floors

Local economy

Neighborhood centers

Active ground-floors

Public-private transition

Source: TOD Guide for Urban Communities (EMBARQ)

10/31/2017

Prof. Sanjay Gupta SPA
Public Spaces and natural resources

Strategic green areas

Energy, water and waste efficiency

Public space networks

Public life

Source: TOD Guide for Urban Communities (EMBARQ)

Prof. Sanjay Gupta SPA

10/31/2017
Community involvement and Identity

Citizen relationships

Place identity

Community management

Sharing the street
Suggested Guiding Principles for City Planning to promote integrated land use-transport structure

- Concentrate urban growth, limit sprawl and provide for mixed land use through urban structure and land use policies, smart growth strategies
- Discourage planning and development of dispersed low density suburbs
- Encourage moderately high densities along public transport routes with some degree of concentration (compact development)
- Ensure siting of new developments along transport corridors to tap accessibility advantages
- Locate high density development in close proximity of mass transit stations (Transit Oriented Development).
Thank You