Land use Planning and Transport Demand Management

Stefanie Holzwarth, Urban Mobility Unit, UN-Habitat
**Land Use and Transport – Exploring the relationship**

**Modal split of all trips, world cities (%)**  
(Kenworthy, 2003)

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>ANZ</th>
<th>CAN</th>
<th>WEU</th>
<th>HIA</th>
<th>EEU</th>
<th>MEA</th>
<th>LAM</th>
<th>AFR</th>
<th>LIA</th>
<th>CHN</th>
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</thead>
<tbody>
<tr>
<td><strong>Non-motorized</strong></td>
<td>8.1</td>
<td>15.8</td>
<td>10.4</td>
<td>31.3</td>
<td>28.5</td>
<td>26.2</td>
<td>26.6</td>
<td>30.7</td>
<td>41.4</td>
<td>32.4</td>
<td>65.0</td>
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<tr>
<td><strong>Motorized public</strong></td>
<td>3.4</td>
<td>5.1</td>
<td>9.1</td>
<td>19.0</td>
<td>29.9</td>
<td>47.0</td>
<td>17.6</td>
<td>33.9</td>
<td>26.3</td>
<td>31.8</td>
<td>19.0</td>
</tr>
<tr>
<td><strong>Motorized private</strong></td>
<td>88.5</td>
<td>79.1</td>
<td>80.5</td>
<td>49.7</td>
<td>41.6</td>
<td>26.8</td>
<td>55.9</td>
<td>35.4</td>
<td>32.3</td>
<td>35.9</td>
<td>15.9</td>
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**USA US**  
**ANZ Australia/New Zealand**  
**CAN Canada**  
**WEU Western Europe**  
**HIA High income Asia**  
**EEU Eastern Europe**  
**MEA Middle East**  
**LAM Latin America**  
**AFR Africa**  
**LIA Low income Asia**  
**CHN China**

**Brainstorm:**

What explains these differences?

1-2-ALL
- 1 minute alone
- 2 minutes in pairs
- Plenary discussion
Opening Questions for a quick Brainstorm

Brainstorm Results (Example) – “Mobility is a complex system”:

e.g. Urban form, infrastructure, availability of transport systems, income, cultural norms, weather, public fund allocation etc.

>> All these factors explain different modal shares in different continents

>> Many cause effect relationships
What patterns/relationships can you see?

Home-work trip characteristics in high income world cities

<table>
<thead>
<tr>
<th></th>
<th>Modal split (%)</th>
<th>Home-work distance (km)</th>
<th>Density (inh/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Car</td>
<td>Public transport</td>
<td>Non-motorized</td>
</tr>
<tr>
<td>North America</td>
<td>86.6</td>
<td>9.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Western Europe</td>
<td>42.8</td>
<td>38.8</td>
<td>18.4</td>
</tr>
<tr>
<td>High income Asia</td>
<td>20.1</td>
<td>59.6</td>
<td>20.3</td>
</tr>
</tbody>
</table>

Patterns:
- Non-motorized ← → shorter distance/higher density
- Public Transport ← → higher density
- Car Usage ← → longer distance/lower density

Relationships:
- Speed ← → distance [car & PT vs. NMT]
- Capacity ← → density [car vs. PT] >> higher density requires higher capacity due to limited space

Underlying mechanisms:
- Acceptable travel time → speed/distance
- Mutual support → capacity/density

Transport mode characteristics

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Average speed (km/h)</th>
<th>Maximum capacity (p/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car (urban street ↔ highway)</td>
<td>30 ← → 76</td>
<td>2.000 ← → 6.000</td>
</tr>
<tr>
<td>Public transport (bus ↔ metro)</td>
<td>15 ← → 40</td>
<td>10.000 ← → 80.000</td>
</tr>
<tr>
<td>Non-motorized (walking ↔ cycling)</td>
<td>5 ← → 12</td>
<td>19.000 ← → 14.000</td>
</tr>
</tbody>
</table>

(Various sources, indicative)

>> Multiple Cause Effect Relationships
City Typologies – based on their transport mode

Non-motorized transport oriented city:
high functional mix

Paris

- Jobs, services
- Homes
City Typologies – based on their transport mode

Public transport oriented city:
high functional separation, high density

Tokyo
City Typologies – based on their transport mode

Car oriented city:
high functional separation, low density

[Diagram of a car-oriented city with jobs/services and homes]
Linking Land Use and Transport

Higher density requires higher capacity due to limited space.

Acceptable travel time

Distance Speed

Mutual support

(Bertolini & le Clercq, 2003)
City typology based on their transport mode

Acceptable travel time

Distance
Speed

Density
Capacity

Car
PT
Cycling & walking

Mutual support

Tokyo

Paris

Los Angeles

(Bertolini & le Clercq, 2003)
Acceptable Travel Time has been constant – after 50 years investing in travel time savings!!

- Relatively constant daily travel times over time
- But **distances** and **speed** has increased
- Often through increasing **car** ownership
- Urban **Sprawl** / pulling activities apart
- In turn, maximizing **speed** even more >> cities for cars

(Schafer, 2000)
Higher Traffic Speeds and less congestion - Are these good goals?

Speed spreads the city and does not save time

The fast city

The slow city

>> Which one do you prefer?
Threshold of Density – The “Car” Case

There is a threshold of density for the car. Example: Los Angeles, Chinese Megacities.

Mutual support $\rightarrow$ + car - density

Example: Los Angeles, Chinese Megacities

There is a threshold of density for the car.

(based on Kenworthy & Laube)
Threshold of Density – The “Public Transport” Case

There is a threshold of density for public transport. Example: Cape Town BRT

(based on Kenworthy & Laube)
Chicken & Egg: Transport - Land Use Feedback Cycle
Transport - Land Use Feedback Cycle

Transport (networks)

Accessibility

Activities

Land use (locations)

- Transport developments determine the accessibility of locations
- Movements between different locations of activity have to be served by transport
- Attractiveness of a location (and its accessibility) determines land use developments
- Land use partly determine the places at which people carry out activities
Mutually reinforcing policy combinations in transport/land use

**Transport policy**
- ICT infrastructure
  - Facilitate (infrastructure)
  - Increase speed, flexibility
  - Selective use (pricing)

**Activity coupling**
- Without travel
- Walking, cycling
- By transit
- By car

**Land use policy**
- Multifunctional homes/workplaces
- Diverse neighborhood/city
- Concentration around stations
- Balanced region

(Bertolini & le Clercq, 2003)
Let’s dive deeper – how does it look like if we plan for Car Oriented Cities?

Car oriented city: high functional separation, low density

Los Angeles
The Urban Transport Challenges

Growing Economy
- Increased Car Ownership
- Increased Traffic Volumes
- Increased congestion

Road Safety
- Increased speed
- Increased conflicts among modes
- Increased accidents

Urban Sprawl
- More car dependency
- Increased trip lengths
- High costs for extending infrastructure and services

Energy Consumption
- Transport consumes 30% of total energy
  - Increased demand for fossil fuel
  - Increased GHG emissions

Climate Change
- Global warming
- Higher emission levels
- Air and noise pollution
Effects of Car Oriented Planning – Traffic concentrates on a few arterial roads
Typical zoning plan in a car oriented approach

- Large blocks of uniform land use. Minimal mixed use zones
- Uniform housing typology in each residential block
- Single business district
Sprawl and low density growth – Residential suburbs in the car-oriented planning

- Low rise, low density development consumes unending amounts of land
- Travel distances increase due to lack of mixed-use
- Increase in vehicular pollution
- Far away from the business district

Ulaanbaatar, Mongolia
The Business District in the car-oriented approach

- Uniformly commercial / business land use. Far from residential areas
- High rise developments. Inhuman scale.
- Floating population. Shuts down at night, leading to problems of safety and security

Houston, TX, USA
Failure of Existing (Public) Transport Network

Traffic dependent on major arterial roads even for short Local Trips!
Road Infrastructure in the car-oriented approach

- Massive roads, with costly infrastructure like grade separation
- Requires huge tracts of land
- Unidirectional traffic congestion: towards the business district in the morning and towards the suburbs in the evening

Ontario Highway 401, Canada –
So what is the impact of the car-oriented approach to land use and transport planning?

Everybody has to buy a car.
High density does not necessarily mean high-rise

- Mid-rise development (say 80% residences in 6-10 storey apartments) is optimal
- It is important to note that most S. Asian cities already have high densities

Densities in 7 major cities at the same scale in a 3 dimensional view
High density can be a blessing and a curse!

High density and mixed land use encourages walking and public transport.

High densities and limited space for streets might constrain supply of public transport and adequate walking facilities.

Name advantages and disadvantages of a dense city? 1-2-All
Transport Demand Management (TDM)

- Maximizes the efficiency of the urban transport system by discouraging unnecessary private vehicle use and promoting more PT and NMT.
- Influences travel behaviour in order to reduce or redistribute travel demand.
# Examples of TDM Measures

<table>
<thead>
<tr>
<th>Improve Transport Options</th>
<th>Economic Measures</th>
<th>Smart Growth and Land Use Policies</th>
<th>Other Programs</th>
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<tr>
<td>Public transit improvements</td>
<td>Congestion pricing</td>
<td>Smart growth</td>
<td>School and campus transport management</td>
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<tr>
<td>Walking and cycling improvements</td>
<td>Distance-based fees</td>
<td>Transit-oriented development</td>
<td>Freight transport management</td>
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<tr>
<td>Mobility management marketing programs</td>
<td>Commuter financial incentives</td>
<td>Location-efficient development</td>
<td>Tourist transport management</td>
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<tr>
<td>Rideshare/commute trip reduction programs</td>
<td>Parking pricing</td>
<td>Parking management</td>
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<td>HOV priority lanes</td>
<td>Parking regulations</td>
<td>Car-free planning</td>
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<tr>
<td>Flextime/telecommuting</td>
<td>Fuel tax increases</td>
<td>Traffic calming</td>
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<td>Carsharing services</td>
<td>Transit encouragement</td>
<td>Transport planning reforms</td>
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<td>Taxi service improvements</td>
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<td>Guaranteed ride home program</td>
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<td>Shared bicycle services</td>
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(A. Broaddus, T. Litman, G. Menon 2009, Transportation Demand Management, Eschborn, Germany)
Developing a comprehensive TDM Strategy

• include an appropriate set of measures;
• identify synergistic effects, that are greater than the sum of TDM measures implemented individually;
• include both positive (“pull”) incentives, such as improved travel options, and negative (“push”) incentives, such as road and parking fees.

<table>
<thead>
<tr>
<th>PUSH</th>
<th>PULL</th>
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</thead>
<tbody>
<tr>
<td><strong>Policy/Regulatory/Economic Measures</strong></td>
<td><strong>Incentives for commuters</strong></td>
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<tr>
<td>- Restrict car access</td>
<td>- Improve transit services</td>
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<td>Increase system and fare structure</td>
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<td></td>
<td>network of priority transit corridors</td>
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<td>- parking spot cashout</td>
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<td>- tax reduction for transit pass</td>
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<th><strong>Physical/Technical Measures</strong></th>
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<tr>
<td>- Reduce car mobility</td>
<td>- Improve quality of transit service</td>
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<th><strong>Plan/Design Measures</strong></th>
<th><strong>Planning for nonmotorised transport</strong></th>
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<tbody>
<tr>
<td>- Integrated land use planning</td>
<td>- street design for bicycles/pedestrian traffic</td>
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<th><strong>Support Measures</strong></th>
<th><strong>Public awareness</strong></th>
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<tr>
<td>- Lines, tickets and towing</td>
<td>- Marketing transit/explaining need for TDM measures</td>
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- **transit oriented development**
Transit-Oriented Development

Public Transport integrated with Walking and Cycling

Stefanie Holzwarth, Urban Mobility Unit, UN-Habitat
Brainstorm: What do you (as the customer) want from Public Transport?

- Convenience
- Easy Access
- Comfort
- Frequent Service
- Rapid journey
- Safety & Security
- Customer Service
- Affordability
- Have a network

Public Transport should be designed around the customer and not around a technology
The conventional vs. the participatory approach

Which one is which?

Step 1. Choose technology
- Technology chosen due to manufacturer lobbying efforts
- Design chosen to please existing operators
- Technology chosen to help property developer

Step 2. Fit city to the technology
- Reduce size of network due to financing limitations
- Charge higher fares in attempt to pay for expensive system
- Operate infrequent services to reduce operating losses
- Require large subsidies for lifetime of system's operation

Step 3. Force customer to adapt to technology
- Extensive marketing campaign to convince customers that system is in their interest

Step 1. Design a system from customer's perspective
- Rapid travel time
- Few transfers
- Frequent service
- Short walk to station from home/office
- Full network of destinations
- Low fare cost

Step 2. Evaluate customer-driven options from municipality perspective
- Low infrastructure costs
- Traffic reduction benefits
- Environmental benefits

Step 3. Decision
- Technology decision based on customer needs and municipality requirements

- Safe vehicle operation
- Secure environment
- Comfortable and clean system
- Friendly and helpful staff
- Economic/employment benefits
- Social equity benefits
- City image
Different MRT options available

Selection Criteria for MRTs:

- Availability of the mode to meet demand
- Cost
- Right-of-way availability
- Environmental impact
- Journey time
- Safety
- Comfort
- Flexibility
- Reliability
- Fare
- Technical sophistication
- Implementation complexities
- Image
Choosing modes – Carrying Capacity
(people per hour on 3.5 m wide lane in city - PPHPD)

Mixed Traffic: 1500 - 2000
Regular Bus: 5000
Cyclists: 14000
BRT single lane: 19000
Pedestrians: 18000 - 20000
Light Rail: ??
BRT double lane: 14000 - 19000
Heavy Rail/Metro: 40000 - 60000
Suburban Rail (e.g. Mumbai): 60000 - 90000

PPHPD
Range (→): 2000
Maximum PPHPD achieved & where (→): 17000, Curitiba, 19000, 20000, 43000, Bogotá, 80000, HKK, >100000, Mumbai
No System Dominates – it depends on what your city needs / what citizens are looking for
Financial Benefit – What a city can have for 1Bn USD?

Example from Bangkok, Thailand

- **BRT**
  - US$ 0.5 – 15 million / km

- **Tram**
  - US$ 10 – 25 million / km

- **Light Rail Transit (LRT)**
  - US$ 15 – 40 million / km

- **Urban commuter rail**
  - US$ 25 – 60 million / km

- **Elevated rail**
  - US$ 50 - 125 million / km

- **Metro**
  - US$ 60 million – 320 million / km
Selection Criteria for MRTs: Performance/Speed
Transit-Oriented Development

Just being adjacent to transit doesn’t mean it’s “transit-oriented”
So what is ToD?

- TOD brings compact, mixed-use development within walking/cycling distance of high capacity rapid transit >> create compact city regions with short commutes

- If well planned and designed, corridors present a spatial context for designing a network of TODs

Density | Connectivity | Diversity | Placemaking
High Quality Transit is accessible by foot

RAPID TRANSIT

= HIGH-QUALITY
HIGH-CAPACITY
HIGH-SPEED
CUSTOMER-ORIENTED
PUBLIC TRANSPORT
Elements of transit-oriented development (TOD)

- High job & residential density
- Compact urban form
- Parking reform
- Good last mile connectivity
- Mixed use buildings
- Rapid transit
- Dedicated cycling infrastructure
- Adequate pedestrian infrastructure

Guangzhou - Zhongshan Dadao
Encourage Intensification of uses along rapid transit corridors
Add density along transit corridors/ circular connections
Integrate different MRT options
Integrate different Transport options
Integrate different Transport options

Cycle parking at transit stations

Cycle parking in paid area of BRT
Fine grid of streets with smaller blocks

- Ahmedabad

  - No. of existing blocks: 31
  - Area under public domain (streets): 22%
  - Average Perimeter: 743m

  - No. of proposed blocks: 76
  - Area under public domain (streets): 40%
  - Average Perimeter: 361m

Ahmedabad
Prioritised connectivity for NMT users

- Pedestrians and cyclists
- Pedestrian-only
- Walking and cycling routes are shorter than motor-vehicular routes

Maximum block size for pedestrians: 100 m

Road network for all modes
Smaller Blocks are important

Dense network of direct short paths to improve accessibility...

...12 km walk
Building design regulations that promote street life

Upper Hill: Compound Walls

Windows and shops overlooking walkways
Lower supply of parking in areas well served by rapid transit
First of all, parking is a commodity, not a right. It comes with a price.

I bought a car but the government hasn't given me a free place to park!

I bought an air conditioner but the government hasn't given me a free house in which to install it!
What should the government provide?

Car parking spaces for a few?

OR

Walking, cycling & public transport for all?
Parking Policy

Parking policy: Old school

1. Increase in private vehicle use is a given.
2. Parking is a public good. People need it.
3. Govt constantly increases supply of subsidized public parking space—especially through multi-level parking.
4. Govt pushes private buildings to create more private parking space through regulation.
5. Govt creates more road infrastructure to cater to the ever increasing number of vehicles attracted to parking.

Parking policy: Smart cities

1. It is impossible to cater to unending parking demand.
2. Parking is a commodity, not a public right
3. Restrict total supply of parking in every zone: paid parking (on/off street) and private parking (in buildings)
4. Govt charges high user fee for available parking spaces to dissuade excessive motor vehicle usage
5. Govt spends the substantial revenue generated to improve public transport and walking/cycling facilities for all citizens
Utilize the gained space for the PEOPLE

• Introduce parking regulation and management; introduce a cap on parking supply/eliminate parking maximums
Prevent accidents through speed control

4,000 spaces removed to make space for 1,451 new Velib stations (public cycle sharing system with 20,000 bicycles)
Prevent accidents through speed control

Keeping vehicle speed low is crucial for pedestrian/cycling safety

Source: ITDP
All streets need slow zones

For narrow ROWs, the entire width should be designed as a slow zone.

On wider streets, a separate slow zone is necessary.
Slower Speed saves lives

Motor vehicle speeds above 30 km/h significantly increase the risk of fatalities.
UN-Habitat/ ITDP guide for improved street design

Streets for walking & cycling
Designing for safety, accessibility, and comfort in African cities
Clear demarcation of 3 zones:

1. **Pedestrian zone:** continuous space for walking (minimum 2 m)

2. **Frontage zone:** buffer between street-side activities and the pedestrian zone

3. **Furniture zone:** space for landscaping, furniture, lights, bus stops, signs and private property access ramps
Great example: Chuncheon
Great example: Chennai
Footpaths should be elevated above the carriageway, with a kerb height of no more than 15 cm.
Flat walking surfaces & guide tiles contribute to accessibility for people with disability.
Great example: Chuncheon

Tactile Design to ensure accessibility for all
Design Example: Crossing

- Pedestrians remain at the level of the footpath
- Ramps to reduce vehicle speeds

Safe At-Grade Crossings
- Pedestrians remain at level of footpath
- Ramps
Great example: Chuncheon

Elevated pedestrian crossing forces cars to slow down
Great example: Chuncheon

Ramps helps Elderly to move around town
Footpath should maintain a constant level, while vehicles should use ramps to reduce speed.
If possible, avoid: Foot overbridges & subways

• In an attempt to increase motor vehicle speeds, at-grade pedestrian crossings are frequently replaced by foot overbridges or subways

• But these facilities are often inaccessible and have drawbacks, such as (Brainstorm):
  
  Increase in travel time
  Lack of universal access
  Obstructions on footpaths
  Prohibitive cost
  Harassment and other crimes
  Increased vehicle speeds
Preferred choice by pedestrians: At grade crossing

Foot overbridges often obstruct footpaths and cycle tracks, making them completely inaccessible.

Footbridges often represent a wasted investment. When presented with a choice, pedestrians prefer to cross at street level.
Cycle tracks require a width of 2 m or one-way movement and should be raised above the carriageway.
This cycle track is physically separated from the carriageway and is wide enough for cyclists to overtake one another.

Painted cycle lanes are not clearly visible in the streetscape and do not offer a safe riding environment.
Great example: Chuncheon
Safe Intersection Design

- direct, intuitive pedestrian crossings
- reflect pedestrian desire lines, avoid detours
- crossing distances should be minimised
- pedestrian refuges large enough to handle observed pedestrian volume

An intersection should be sized to minimize crossing distances for pedestrians and cyclists while accommodating left turns of a design vehicle (e.g., a 12 m bus).
Sharp corner forces cars to slow down

Source: ITDP
UN-Habitat Project Example: Bucaramanga
Build roads
Add traffic jams
Add pollution
Add road deaths

Cities for cars
Cities for people

Add transit
Add density
Cut parking
Better quality of life!
Thank you!

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