INTEGRATION OF PUBLIC TRANSPORT AND NMT

PRINCIPLES AND APPLICATION IN AN EAST AFRICAN CONTEXT

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CONTENTS

- Examples of integration from the Netherlands
- Rationale and principles of integration
- Types of integration
- The multimodal trip
- Integration at different scale levels: facility, network, city.
- The role of the bicycle
- Public Bike Systems
- Modeling multimodal systems in GIS
- Discussion: How to implement integrated NT-NMT systems in East African cities.
LEARNING OBJECTIVES OF THIS LECTURE

After this lecture students should be able to:

- Discuss theoretical concepts of PT-NMT integration
- Describe different concepts of integration at different scales (urban, network, facility level)
- Appreciate the role of Public Bike Systems in contributing to an integrated transport system
- Get an idea of what a GIS based multi-modal model looks like

Mode: Lecture and discussion
EXAMPLE: BICYCLE AS AN ACCESS MODE TO STATIONS IN THE NETHERLANDS

- Of all train travellers in The Netherlands, no fewer than 40% use the bicycle as an access mode.
- The explanation for the high bicycle share lies primarily in the fact that 45% of all Dutch people live no more than 3 km from a station.

(Fietsberaad, 2009)
More than 350,000 egress trips a year by rented OV Fiets (PT bike); expected to be 1 million in 2011.

This scheme is mostly used for business purpose (49 percent of the trips).

35% of subscribers travel more frequently by train and 12% sometimes or regularly leave their cars at home.

OV-fiets is now becoming available for rent at larger bus stations, in town centres and business parks.

(Fietsberaad, 2009)
BUSES AND BIKES: FRIENDS OR FOES?

- **Cycling:**
  - No emission, personal means of transport
  - Door to door
  - Available throughout the day
  - Fast and efficient at short distances

- **Buses (in formal systems, how about informal?)**
  - Low emission, public means of transport
  - Spatial coverage high, but dependent on stops
  - Time table
  - Slow and inefficient at short distances

- Bikes and buses can be complementary by providing efficient and sustainable door-to-door service to the commuter
Integration of bicycles into multi-modal transport chains, particularly with public transport (PT) modes, contributes to a more efficient and environmentally sustainable transport system.

A well integrated bus-bike system increases bus ridership levels.
WHY BOTHER?

- Public transport systems, particularly in larger cities in many African countries are usually dense enough to make the PT stations accessible by walking; and there are no facilities for cycle parking at bus stops ...
- So, do we need to look at integrating cycling and PT?
- Perhaps in relation to mass transit systems like BRT!
  - Low density networks
  - High quality bus stop/station locations
  - NMT infrastructure provisions alongside corridor
TYPES OF INTEGRATION

1. **fare integration**: provision of integrated ticketing, one ticket including for parking/renting of bike

2. **information integration**: information on almost all aspects of travelling in every mode

3. **operational integration**: of different PT systems and operators

4. **physical integration**: “seamless” trips with transfer facilities continuously improved and provided

5. **network integration**: integrating different hierarchical levels and connecting modes

(adapted Ibrahim, 2003)
SPATIAL LEVELS OF INTEGRATION

1. Facility level: the nodal interchanges and bike paths
2. Network level: the integrated transport system
3. Urban level: the land-use transport system

(picture: TRIPP)
1. time that can be attributed to the transfer of modes:
   - walking distance from parking to the bus or train.
   - average time needed to park and pay (if applicable) for the bicycle storage.
2. costs that can be attributed to the transfer of modes:
   - costs to park the bicycle (park and ride).
3. service, safety and comfort:
   - security and safety for both the bicycle as well as the users
   - availability of the parking facility around the clock
   - service from before to after the scheduled departure and arrival times of buses
   - stairs (i/a) to enter or exit the facility with a bicycle and from the bike parking to the platform (i/a)
   - quality of storage (racks, bicycle maintenance service)
   - bicycle renting possibility
   - attractiveness visual appearance and convenience of the bicycle parking facility as well as its direct surroundings
INTEGRATION AT THE FACILITY LEVEL

Good quality bicycle infrastructure from/to the stops/stations:

1. **Consistency**: the cycle infrastructure should be an uninterrupted consistent whole, connecting points of departure and destination.

2. **Directness**: cycle tracks are preferably the shortest possible routes between points of departure and the destinations (bus stops).

3. **Attractiveness**: lighting, shelter, traffic signs, intersection priorities etc. should be well designed and operational.

4. **Road safety**: smooth pavements, lighting and removal of dangerous junctions (accident hotspots) to ensure safe routes to the stops.

5. **Convenience**: preventing steep slopes, dangerous curves, open drainages, street hawkers and parked vehicles on the bike lanes.
INTEGRATION AT THE FACILITY LEVEL

Additional facilities:
1. Bike storage facility at the home and non-home end of the trip.
2. Public bike schemes.
3. Bicycle rent schemes integrated with public transport systems.
INTEGRATION AT THE NETWORK LEVEL

- Cycling potential in an integrated trip is a function of the public transport network lay-out and structure.
- Bike access trip are probably better accommodated in public transport system’s with a relatively low bus stop density.
- Walking access is better accommodated in public transport systems with a high bus stop density.

An access network

A connecting network
INTEGRATION AT THE URBAN LEVEL

- At the highest level of integration the bus-bike system (supply) is compared to trip demand (potential) of locations

(Krygsman et al., 2004)
THE INTEGRATED BUS-BIKE SYSTEM

Consists of:

1. Multi-modal transfer facilities (at interchanges or stops) that are fast, cheap, accessible, safe and convenient.

2. A connecting public transport network, implying low density of stops and stations (system), or an access public transport network with a low density of facilitated bus stops and stations.

3. An integrated bus - bicycle network (system), i.e. access bike network linked to the connecting public transport network, and/or;

4. An access public transport network (public transport feeding system) with a bus stop density complementing the bicycle as an access mode.

5. Integration points (lines and stops) well located as per the optimal catchment of potential users (of the integrated bicycle-bus system) in the urban area.
TARGET USERS OF THE INTEGRATED BUS BIKE SYSTEM

1. **current PT users**, that would potentially benefit from an improved quality of their trip.

2. **current cyclists**, that would potentially benefit from increased opportunities to reach more trip destinations at different distances/travel times, within their travel time budget.

3. **potential users of PT** that are using other motorised modes such as motorcycles.

4. **pedestrians**, that may shift to bicycles in case favourable conditions are created.

5. ... **current car users**, aiming at providing an attractive trip chain that will induce them to switch to cycling and PT.

*choice travellers, but what about captive bike riders?*
HOW TO PROMOTE INTEGRATION?

AT THE FACILITY LEVEL

- Capacity
  - Capacity fits bicycle parking demand
  - Integrated ticketing and fare systems
  - Frequent traveler incentives (discount, priority parking)
  - Priority parking (women)
- Seamless access between parking and platform
  - Good station design
  - Accessible bicycle parking
  - Shortcut from bicycle parking to platform
- Service levels
  - Guarded bicycle parking from before the first service till after the (delayed) last service
  - Bicycle maintenance, puncture service
  - General supplies shop
HOW TO PROMOTE INTEGRATION?

At the network level

- Bicycle network
  - Complying with route quality criteria (consistency, directness, attractiveness, road safety)
  - Bicycle network integrated with public transport network (particularly at the most important public transport stops)
- Bus route network
  - Bus route network integrated with bicycle network (particularly at the most important public transport stops)
At the urban level

- The integrated bus-bike network is planned as such to optimize the catchment of bus-bike users.
- Integrated land use – transport policy and planning
PUBLIC BIKE SYSTEMS
WHAT ARE THEY?

- Hot and Cool

- A typical Public Bike System consists of: (litman, 2012)
  - A fleet of bicycles
  - A network of automated stations (also called *points*) where bikes are stored
  - Bike redistribution and maintenance programs.
  - Bikes may be rented at one station and returned to another.
  - Stations with automated self-serve docking systems for 5-20 bikes
  - Use is free or inexpensive for short periods (typically first 30 minutes).
  - Allows residents and visitors to bicycle without needing to purchase, store and maintain a bike.
  - PBS are most efficient when bikes are shared many users each day; some systems average as many as twelve daily users per bike.
### PROS AND CONS OF PBS

<table>
<thead>
<tr>
<th>Pros (Litman, 2012)</th>
<th>Cons ?</th>
</tr>
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<tbody>
<tr>
<td>Congestion Reduction</td>
<td>Reverse logistics</td>
</tr>
<tr>
<td>Road &amp; Parking Savings</td>
<td>Empty and full stations</td>
</tr>
<tr>
<td>Consumer Savings</td>
<td>Theft</td>
</tr>
<tr>
<td>Transport Choice</td>
<td>Not custom built for person, 1 size fits all</td>
</tr>
<tr>
<td>Road Safety</td>
<td>High cost for operator (society)</td>
</tr>
<tr>
<td>Environmental Protection</td>
<td>Public space use</td>
</tr>
<tr>
<td>Efficient Land Use</td>
<td></td>
</tr>
<tr>
<td>Community Livability</td>
<td></td>
</tr>
</tbody>
</table>
PUBLIC BIKE SYSTEMS
DOES THIS MAKE SENSE IN THE AFRICAN CONTEXT?

- No systems implemented as yet.
- Plans for Accra.
- Would this make sense in Kisumu? Other cities?
MODELLING BUS-BIKE INTEGRATION IN GIS

- Not a transport model!
- A spatial planning tool for PT integration
- Case study Ahmedabad
  - 6 million inhabitants
  - Multi-nuclei, high density, mixed LU
  - BRT operational, extensive bus network
  - Bicycle city, some bike infrastructure
THE PT MODELING PROBLEM – THREE MAIN APPROACHES

Main challenge: representing the complexity of the integrated PT system.
Three approaches in theory
  - Using basic network data models, each PT line needs to be digitized separately
  - Using external tables for routes (dynamic segmentation) does not support network graph theoretical approaches
  - 3-D models
MODELING THE PT TRIP SEQUENCE

1. Home
2. Nearest suitable bus stop or transfer station and ticket purchase
3. Waiting Time
4. Boarding
5. Bus Line travel time
6. Is the final Destination reached?
   - Yes
   - No
7. Transfer
8. NMT Access Trip (Walk or bike)
9. Alighting

Integration of Public Transport and Non-Motorised Transport: Walking or Bike

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INTEGRATED MULTI-MODAL PT NETWORK
CURRENT AND FUTURE PUBLIC TRANSPORT MODES
3D MULTI-MODAL TRANSPORT NETWORK
AHMEDABAD
Network Dataset
The sources and The role

Available Data
Ahmedabad_Studio.gdb

Network Dataset
Model connectivity

Pedestrian Network
AMTS Bus Lines
AMTS Bus Links
AMTS Bus False Stops
BRTS Bus Lines
BRTS Bus Links
BRTS Bus False Stops
MRTS Metro Lines
MRTS Bus Links
MRTS Bus False Stops
MRTS Metro Stations
Pedestrian Network

Integration of Public Transport and Non Motorised Transport
5/16/2014
NETWORK IMPEDANCES
ALL MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Speed km/h</th>
<th>Speed m/m</th>
<th>Access min.</th>
<th>Egress min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>3.5</td>
<td>58.88</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cycling</td>
<td>12</td>
<td>200</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>AMTS</td>
<td>15 - 20</td>
<td>250 - 333.33</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>BRTS</td>
<td>25</td>
<td>416.67</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>MRTS</td>
<td>35</td>
<td>583.33</td>
<td>3.75</td>
<td>2</td>
</tr>
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</table>
DISCUSSION
HOW TO IMPLEMENT INTEGRATED NT-NMT SYSTEMS IN EAST AFRICAN CITIES?

Discuss in small groups the following questions:

Which types of cities are suited to develop integrated PT-NMT systems, what are the criteria required?
Which type of integration are we after?
Which facilities are needed?
How is the transport system as a whole changed?
What is needed in terms of education, stakeholder involvement etc.?
THANK YOU FOR YOUR ATTENTION