Transport and metropolitan growth strategies for more sustainable mobility development

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A six point exposé (a)

1. Un-sustainable development of urban mobilities: case of PARIS REGION (Ile de France)
2. “Urban density” and “mobility” multiple interdependences
3. Car ownership evolution
1. Un-sustainable development of urban mobilities

In most European metropolitan areas:

- Higher density metropolitan central areas, where public transport is the most attractive and efficient, are losing population and jobs.

- Low density peripheral sectors, where public transport is much less attractive and efficient, and where the automobile is dominant, are gaining population and jobs.
...public transport improvements and automobile dependence

- Substantial public transport service improvements are not capable, by themselves, to trigger a reduction of automobile dependence

- Ever growing low density metropolitan sprawl, dispersed employment, car ownership growth and longer work-travel journeys are contributing factors to public transport relative decline

...systematic Mobility Plan updates

- Most european metropolitan transport policies are revised every five years to comply with new environmental legislations

- New mobility plans contain invariably the same main recommendations:
  - *significant public transport strengthening is needed to serve old and new developments*
  - *tighter control of automobile traffic and parking must be implemented to reduce car dependency*
... current trends are the opposite

- In the Paris Region (11.5 millions inhabitants) 15 year mobility trends indicate:
  - automobile travel + 35 %
  - public transport travel + 5 %
  - walking and two-wheel travel - 20 %

- If no significant policy changes are made, the Paris 2015 Master Plan will lead to:
  - + 55 % of motorized passenger-kilometers
    - of which 2/3 by private cars
Paris Region motorization and modal split patterns

Ile de France Region mobility patterns
2. “Urban density” and “Mobility” multiple interdependences

... growing mobility parameters with higher urban density

- public transport modal share
- non-motorized (on foot+bicycle) modal share
- parking costs
- housing and accommodation budget
increasing mobility parameters with decreasing urban density

- private car modal share
- car ownership
- public and private parking availability
- average daily travel distance budget
- average travel commercial speed
- average transport cost budget
- transport energy consumption

constant mobility parameters

Surprisingly enough, in a high mobility Environment, two mobility parameters remain constant (Zahevi paradigm):

- average daily travel time budget
- average daily number of journeys per capita
### Figure 1: Typology of average metropolitan densities and transport selected parameters

<table>
<thead>
<tr>
<th>Density (h+j/ha)</th>
<th>LOW</th>
<th>INTERMEDIATE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 25 h+j/ha</td>
<td>50-100 h+j/ha</td>
<td>&gt; 250 h+j/ha</td>
</tr>
</tbody>
</table>

#### Indicative overall modal distribution

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile use (km/person/year)</td>
<td>&gt; 10'000</td>
</tr>
<tr>
<td>Public transport use (journeys/person/year)</td>
<td>&lt; 50</td>
</tr>
<tr>
<td>Fuel/gasoline consumption in transport (MJ/person/year)</td>
<td>&gt; 55'000</td>
</tr>
</tbody>
</table>

#### Representative situations

<table>
<thead>
<tr>
<th>Density (h+j/ha)</th>
<th>North American and Australian metropolises</th>
<th>European metropolises</th>
<th>Asian metropolises and world major city centers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 25 h+j/ha</td>
<td>50-100 h+j/ha</td>
<td>&gt; 250 h+j/ha</td>
</tr>
</tbody>
</table>

**Legend:**
- **CAR**: Car
- **PT**: Public transport
- **NMT**: Non-motorized transport

**Density (h+j/ha)**: number of inhabitants (h) and jobs (j) per net hectare (ha) of urban area (excluding greenspaces, stretches of water)

**Source:** according to Newman/Kenworthy, “Sustainability and Cities”, 1999

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### Figure 2: Distribution of energy consumption in transport and fuel/gasoline consumption across different regions

- **United States**
- **Australia - Canada**
- **Europe**
- **Asia**

**Legend:**
- Energy consumption in transport
- Fuel/gasoline consumption

**Source:** according to Lawrence/Kenworthy, 1999, “Sustainability and Cities”, with the addition of the circles for total energy consumption in transport.
...comparative mobility parameters

Statistics hereafter are from the UITP Millennium City Database. Seven mobility parameters are outlined for some 20 world metropolises:

a) average urban density: habitants/net hectare
b) GDP per capita: GDP in US$/person
c) car ownership: private cars/1000 inhabitants
d) total mobility: total trips/person/day
e) proportion of total mobility by car
f) total transport energy per person in MJ
g) public transport share: %motorized mobility by PT

...low urban density cities

<table>
<thead>
<tr>
<th>1995</th>
<th>Toronto</th>
<th>New York</th>
<th>Los Angeles</th>
<th>Houston</th>
<th>Sydney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (hab/ha)</td>
<td>26</td>
<td>18</td>
<td>24</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>19 000</td>
<td>34 000</td>
<td>28 000</td>
<td>31 000</td>
<td>22 000</td>
</tr>
<tr>
<td>Car ownership (c/1000)</td>
<td>465</td>
<td>445</td>
<td>525</td>
<td>695</td>
<td>515</td>
</tr>
<tr>
<td>Motorcycle own. (m/1000)</td>
<td>(5)</td>
<td>(10)</td>
<td>(10)</td>
<td>(5)</td>
<td>(10)</td>
</tr>
<tr>
<td>Total mobility (trips/day)</td>
<td>1.95</td>
<td>3.30</td>
<td>4.00</td>
<td>4.65</td>
<td>3.85</td>
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<tr>
<td>Mobility by car</td>
<td>79%</td>
<td>75%</td>
<td>88%</td>
<td>95%</td>
<td>76%</td>
</tr>
<tr>
<td>Mobility by bicycle</td>
<td>(1%)</td>
<td>(0%)</td>
<td>(0%)</td>
<td>(0%)</td>
<td>(0%)</td>
</tr>
<tr>
<td>Energy for transport (MJ)</td>
<td>36 000</td>
<td>44 000</td>
<td>52 000</td>
<td>86 000</td>
<td>30 000</td>
</tr>
<tr>
<td>Public transport share (%mot. transp)</td>
<td>13%</td>
<td>9%</td>
<td>2%</td>
<td>&lt;1%</td>
<td>12%</td>
</tr>
</tbody>
</table>
### ...macro characteristics

- Densities < 25 inhabitant / hectare
- GDP/capita > 20’000 US$
- Car ownership > 450 veh./1000 pop
- Car mobility > 75%
- Public transport mot. share < 12%
- Energy for transport > 30’000 MJ

### ...medium density cities

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</thead>
<tbody>
<tr>
<td>Density (hab/ha)</td>
<td>85</td>
<td>50</td>
<td>70</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>18 000</td>
<td>41 000</td>
<td>39 000</td>
<td>23 000</td>
<td>22 000</td>
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<tr>
<td>Car ownership (c/1000)</td>
<td>430</td>
<td>420</td>
<td>375</td>
<td>355</td>
<td>330</td>
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<tr>
<td>Motorcycle own.(m/1000)</td>
<td>(25)</td>
<td>(60)</td>
<td>(30)</td>
<td>(20)</td>
<td>(10)</td>
</tr>
<tr>
<td>Total mobility (trips/day)</td>
<td>1.95</td>
<td>2.85</td>
<td>2.85</td>
<td>3.05</td>
<td>2.80</td>
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<tr>
<td><strong>Mobility by car</strong></td>
<td><strong>30%</strong></td>
<td><strong>44%</strong></td>
<td><strong>42%</strong></td>
<td><strong>44%</strong></td>
<td><strong>49%</strong></td>
</tr>
<tr>
<td><strong>Mobility by bicycle</strong></td>
<td>(0%)</td>
<td>(1%)</td>
<td>(4%)</td>
<td>(6%)</td>
<td>(1%)</td>
</tr>
<tr>
<td>Energy for transport (MJ)</td>
<td>15 000</td>
<td>16 000</td>
<td>17 000</td>
<td>14 000</td>
<td>14 000</td>
</tr>
<tr>
<td>Public transport share (%mot.transp)</td>
<td>22%</td>
<td>24%</td>
<td>25%</td>
<td>28%</td>
<td>27%</td>
</tr>
</tbody>
</table>
...macro characteristics

- Very homogeneous characteristics
- Urban densities 50-85 hab./ha
- GDP / capita 20’000-40’000 US$
- Car ownership > 330 veh./1000 hab
- Car mobility 30-50%
- Public transport share 22-28%
- Energy/transport 14’000-17’000 MJ

...intermediate density cities

<table>
<thead>
<tr>
<th>1995</th>
<th>Tehran</th>
<th>Mexico</th>
<th>Beijing</th>
<th>Bogota</th>
<th>Moscow</th>
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</thead>
<tbody>
<tr>
<td>Density (hab/ha)</td>
<td>115</td>
<td>110</td>
<td>125</td>
<td>115</td>
<td>145</td>
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<tr>
<td>GDP per capita</td>
<td>3 000</td>
<td>4 000</td>
<td>2 000</td>
<td>3 000</td>
<td>5 000</td>
</tr>
<tr>
<td>Car ownership(c/1000)</td>
<td>95</td>
<td>200</td>
<td>45</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td>Motorcycle own (m/1000)</td>
<td>(50)</td>
<td>(5)</td>
<td>(30)</td>
<td>(5)</td>
<td>(5)</td>
</tr>
<tr>
<td>Total mobility (trips/day)</td>
<td>3.00</td>
<td>2.05</td>
<td>2.45</td>
<td>1.55</td>
<td>2.70</td>
</tr>
<tr>
<td>Mobility by car</td>
<td>50%</td>
<td>45%</td>
<td>25%</td>
<td>30%</td>
<td>32%</td>
</tr>
<tr>
<td>Mobility by bicycle</td>
<td>(5%)</td>
<td>(0%)</td>
<td>(38%)</td>
<td>(4%)</td>
<td>(4%)</td>
</tr>
<tr>
<td>Energy by transport (MJ)</td>
<td>6 800</td>
<td>19 400</td>
<td>3 700</td>
<td>7 400</td>
<td>????</td>
</tr>
<tr>
<td>Public transport share(%mot.transp)</td>
<td>36%</td>
<td>38%</td>
<td>53%</td>
<td>67%</td>
<td>68%</td>
</tr>
</tbody>
</table>
…macro characteristics

- Urban densities 110 - 195 hab / ha
- GDP / capita 2000-5000 US$/capita
- Car ownership 45 - 200
- Car mobility 25-50 %
- Public transport share 35-68%
- Energy for transport 3700-19400 MJ

…high density cities

<table>
<thead>
<tr>
<th>Year</th>
<th>Hong Kong</th>
<th>Shanghai</th>
<th>Mumbai</th>
<th>Cairo</th>
<th>Seoul</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Density (hab/ha)</td>
<td>320</td>
<td>200</td>
<td>335</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>GDP per capita</td>
<td>23 000</td>
<td>2 000</td>
<td>1 000</td>
<td>2 000</td>
</tr>
<tr>
<td></td>
<td>Car ownership (c/1000)</td>
<td>45</td>
<td>15</td>
<td>20</td>
<td>50</td>
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<tr>
<td></td>
<td>Motorcycle (m/1000)</td>
<td>(5)</td>
<td>(45)</td>
<td>(30)</td>
<td>(10)</td>
</tr>
<tr>
<td></td>
<td>Total mobility (trips/day)</td>
<td>2.80</td>
<td>3.15</td>
<td>1.30</td>
<td>1.40</td>
</tr>
<tr>
<td></td>
<td>Mobility by car</td>
<td>19%</td>
<td>7%</td>
<td>9%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Mobility by bicycle</td>
<td>(0%)</td>
<td>(45%)</td>
<td>(0%)</td>
<td>(0%)</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td>6 500</td>
<td>2 000</td>
<td>1 500</td>
<td>2 800</td>
</tr>
<tr>
<td></td>
<td>Public transport share</td>
<td>73%</td>
<td>70%</td>
<td>84%</td>
<td>40%</td>
</tr>
</tbody>
</table>
...macro characteristics

- Urban average densities highest in the world > 200 hab / ha
- Car ownership (except Seoul) 15-50
- Mobility by car 7 - 47%
- Public transport share 40-84%
- Transport energy 1500-6500 MJ

...mobility / densities

- Low average urban densities are linked to high car usage and very high transport energy consumption. Car ownership is high as well as GDP/capita

- High average urban densities are linked to high public transport usage and low transport energy consumption. Car ownership and GDP/capita are low to average with considerable variations
3. Car ownership evolution

...the Swiss motorisation case

Representative of Western Europe trends:
- 55 years (1905-1960) to reach 100 autos/1000
- 20 years (1960-1980) to gain 300 autos/1000
- 20 years (1980-2000) to gain another 100 and reach 500 autos/1000
...motorization sustained growth

- Multi-motorisation per household
- Young people motorisation (motorcycle, second hand car, car leasing)
- Higher motorisation in rural and mountain areas than in cities
- Lower motorisation in city centres than suburbs
- Large employer motorisation / car fleets
- Car ownership loosely linked to income

4. Long term orientations

- «Urban planning» and «transport development» are closely interdependent, but are disjointed at most policy and institutional levels
- Urban sprawl and dispersed mobility patterns lead to public transport weakening and less sustainable mobility developments
- Structuring urban form with high density nodes and corridors is of utmost strategic importance
Increasing urban densities in subcenters, urban corridors and nodes

- Most European land planning promote higher densities in areas well served by public transport
- These policies are valid for all new developments
- Dutch ABC policy to match land use densities with appropriate transport means
...two ring metropolitan form

Legend:
- High density metropolitan centre
- Medium density suburbs (Ring 1)
- Low density urban sprawl (Ring 2)
- High density activity node
- Regional Express Rail System

...metropolitan satellite structure

Legend:
- High density metropolitan centre
- Medium density suburbs (Ring 1)
- Low density urban sprawl (Ring 2)
- High density activity node
- Regional Express Rail System
...corridor linear growth

Legend:
- High density metropolitan centre
- Medium density suburbs (Ring 1)
- Low density urban sprawl (Ring 2)
- High density activity node
- Regional Express Rail System
- Corridor development

...peripheral loop growth

Legend:
- High density metropolitan centre
- Medium density suburbs (Ring 1)
- Low density urban sprawl (Ring 2)
- High density activity node
- Regional Express Rail System
- Peripheral loop development
...land and transport planning

- In fast growing cities, it is essential that heavy “rail and road” transport infrastructure development precedes or directly accompanies urban growth.

- Structuring metropolitan development with high density activity + housing nodes and corridors is of utmost importance.

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major boulevard redesign with public transport and higher densities

- Substitution of auto traffic lanes by high performance public transport: light rail, exclusive bus lanes, reserved bus corridors, busways.

- Urban transit mall redesign, larger and more convivial public space, systematic on-street parking removal.
...redeployment of rail systems

- Renewal of under-used freight rail infrastructures
- exclusive right-of-way rail public transport is the most powerful metropolitan transport vector

- Many possibilities to explore and develop:
  - existing line improvement or/and extension
  - freight line conversion to passenger service
  - dualmode interconnection: suburban rail/urban light rail
  - network interconnexion: regional express rail system linkages

5. Short/Medium term orientations

- Urban structuring and transport infrastructure developments have effects on the long term
- Reducing Green House effects calls for faster actions, chiefly in the transport sector
- Short to medium term actions rely more on “transport and traffic management” than on infrastructure development
...short-medium term measures

• Traffic management (TMC)
• Urban congestion pricing
• Traffic calming
• Surface public transport performance improvements
• Parking diversified strategies, controls, taxing

...TMC

• Centralized traffic management command and control is essential to improve metropolitan transport operations
• Integration of all metropolitan transport modes / coordinated information systems
• Integration of global parking supply/demand on time information
• TMC traffic management is crucial to handle mega-event situations like the Olympics
...urban congestion pricing

- “Road pricing” eliminates the 20-25% extra peak traffic load which produces “traffic congestion” in dense city centre
- Road pricing revenue “redistribution” to strengthen public transport
- Road pricing peak traffic load reductions substantially improve public transport operations, a “win - win” solution

...traffic calming

- Main goal = harmonise traffic operations and behaviour with local living needs
- Traffic calming is successfully applied to whole urban areas subdivided in alveolar zones
- Major benefits in terms of security, liveability, conviviality
…public transport performance

- Break the vicious circle of public transport deterioration
- Systematic introduction of public transport priorities
- Gains of up to 25% commercial speed and productivity by appropriate traffic management

…urban parking control strategies

- Control of parking supply is the most powerful mobility management tool
- Commuter modal choice is dictated by parking availability at the work place

- New Mobility Plans include strong metropolitan wide parking control strategies with:
  - new parking standards (ceilings instead of minima)
  - deterrence of free workplace parking
  - parking prohibition on public transport boulevards
  - metropolitan wide park + ride promotion
6. Perspectives (a)

- Metropolitan development structuring with strategic high density nodes or/and corridors is of paramount importance to promote more sustainable mobility development
- Strategic Metropolitan Development Master Plan must not only incorporate the urban expressway and road systems but also extensions of the public transport high performance rail network

...perspectives (b)

- High performance public transport, especially metropolitan rail system and busway systems must be planned “before” or with land development
- Automobile control policies are to be integrated into metropolitan transport master planning such as:
  - congestion toll systems applied to the most heavily loaded urban sectors
  - extensive parking control, charging and guidance systems applied to all dense activity centres
Inversing mobility patterns takes time and very strong planning, policy and implementation actions

For example, when car mobility is growing fast and public transport modal split is decreasing, meeting opposite objectives is very challenging and needs an array of bold policies, traffic management measures as well as strong systematic enforcement.

Inversing travel patterns towards more sustainable urban mobilites

<table>
<thead>
<tr>
<th>Ambitious objectives</th>
<th>Current trends</th>
<th>Trend inversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial value:</td>
<td></td>
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<tr>
<td>FT 1995: V2010</td>
<td></td>
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<td>Ch. trend: 20% by 2015</td>
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<td>2000</td>
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<td>development</td>
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</table>
References (a)


References (b)

- Laconte P. “Cities and transport - the global experience”, PTI-1/99, Bruxelles
References (c)


...end of conference