The Theory of Urban Fabrics: Understanding the Science of Planning Cities

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The Journey....
How did I get from Chemistry to Sustainable Transport....?

PhD in Chemistry 1964-72

Professor, 15 books, 250 articles on sustainable transport...IPCC, IA....
Delft – 1972/73, studying Environmental Science and discovering European cities

Stanford 1973-4 Studying Ecology and discovering...
The Hubbert Peak
Sci Amer 1971

Society collapsing....1973
I needed to find out why cities were so different in how they consumed fuel...

Fuel Use Decreases as Density Increases
Sustainability is reducing the footprint whilst improving the liveability.

Metabolism helps you describe the problem, but what causes the dynamics?

Figure 5. Extended metabolism model of human settlements.
Different parts of the city have very different transport fuel use.

Melbourne....wealthy in the core and inner areas use cars less, and sustainable modes more...

<table>
<thead>
<tr>
<th></th>
<th>Core</th>
<th>Inner</th>
<th>Middle</th>
<th>Outer / Fringe</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Household earning &gt; $70,000</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Car Use</td>
<td>2.12</td>
<td>2.52</td>
<td>2.86</td>
<td>3.92</td>
</tr>
<tr>
<td>Public Transport</td>
<td>0.66</td>
<td>0.46</td>
<td>0.29</td>
<td>0.21</td>
</tr>
<tr>
<td>Walk/bike</td>
<td>2.62</td>
<td>1.61</td>
<td>1.08</td>
<td>0.81</td>
</tr>
<tr>
<td>Area</td>
<td>Gasoline use (MJ per capita)</td>
<td>Density (persons/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central San Francisco</td>
<td>17,449</td>
<td>128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner City (City of San Francisco)</td>
<td>33,337</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle Suburb, with strong sub-centre (Rockridge/Berkeley)</td>
<td>45,548</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle Suburb, with no sub-centre (Walnut Creek)</td>
<td>49,641</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outer Suburb (Danville-San Ramon)</td>
<td>67,090</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Variations in gasoline use and density by area, San Francisco. Source: Holtzclaw, 1990.

Los Angeles:
Density and Public Transport Use

![Diagram showing the relationship between density and public transport use in Los Angeles, with areas marked as core, inner, and outer.](image)
Sydney....three different cities

Outer suburbs residents, particularly those away from rail lines, drive much more than inner suburbs residents.
Perhaps there are three city types?

The development of a model...

Why transportation priorities shape cities...

MARCHETTI CONSTANT
The average travel time budget is around one hour per person per day…. (i.e. half an hour average for the journey to work). Found to apply across the world and throughout urban history.

This means?
THE CITY IS ALWAYS ‘ONE HOUR WIDE’....
TRADITIONAL WALKING CITY

Up To 1850 In Europe

- High Density
- Mixed Use
- Organic Structure
WALKING CITIES

6-8,000 years old, 5-8 km wide. Densities 100-200 people /ha. Mixed. Little other space. Squatter settlements today as well as pre-industrial city centres.
TRANSIT CITIES

Industrial cities meant walking cities had to be rebuilt. Linear infrastructure of pipes and rails enabled city to spread in corridors. Transit city could be 20 to 30km wide. Densities 50-100/ha. Walkable centres at stations.
AUTOMOBILE CITIES

From the 1950’s in America and Australia city planners opted for the new frontier of automobile dependence. Cities could now spread 50 km and in every direction, if it is assumed that automobile access is primary.

Automobile cities require the infrastructure of highways, the dispersed housing of land development and the cultural values of suburbia.

All cities are being shaped in some way by these priorities…. THE PLANNING DEFAULT OPTION....
Bossley Park

Bossley Park

Bossley Park
Town planning then adopted the car-based city as its model....neglecting the other types and treating them as though they did not exist....
The Theory of Urban Fabrics

• All cities have a combination of Walking City, Transit City and Automobile City fabrics.
• The elements of the fabric consist of differences in density, mix, road widths and infrastructure that supports the modes (parking levels, stations, pedestrian and cycling spaces....)
• Planning needs to Recognise, Respect and Repair/Regenerate each urban fabric...

Enter the Finn.....
Recognise…..

• *Recognise* the urban fabrics by careful mapping and especially where the overlaps and transitions occur.
ONE LANE - people per hr:
Freeway 2,500
Busway 5000
LRT 10-20,000
Train 50,000

Respect….

• Respect the urban fabrics as the basis of understanding how the city works and thus how it needs to be planned;
Repair and Regenerate....

- Regenerate the urban fabrics to work more effectively in their walking, transit and car-based functions .... within a sustainability framework to set the objectives.

Restoring ‘place’, eg River in Seoul, buried under freeway
6-1 Cheonggyecheon Area after Restoration

Shanghai 1990 and 2010

1990’s - Flirting with the American model...
Rapidly filled...
So what can be done?

Shanghai Metro...12 lines, 273 stations, 420km covering 80% of metro area...
Built mostly since 2000; carries 8 million per day
Jan Gehl the walkability magician...

Transformation of Broadway
Melbourne.
Places for People
1994
Report by Jan Gehl

Places for People
2004
Report Gehl Architects

www.gehlarchitects.dk

Extention and modernization of the Streetcar System
More People living down town

1983

1992

738 dwellings

• = 5 dwellings
More People living downtown

2002

9,895 dwellings

New Street trees

street trees since 1993

• = 5 dwellings

• convenience store
Outdoor Cafes

Curbside cafes in 1993

Curbside cafes in 2004
New life in the lane ways

Pedestrian traffic weekdays daytime: +40%
Pedestrian traffic evening: +100%
Stationary activities +200-300%
LRT land use...
Sydney Transit City – tram fabric and train fabric

Outer suburbs residents, particularly those away from rail lines, drive much more than inner suburbs residents.

Code Red for outer areas...Sydney

Annual Vehicle Km per Household, 2004

- 2.3 – 7.6
- 7.6 – 10.1
- 10.1 – 12.6
- 12.6 – 15.0
- 15.0 – 18.4
- 18.4 – 24.5
- 24.5 – 39.0
What about the Automobile City?

- What does the theory suggest we do....

New Urbanism experiments in Perth....
Even with permeable streets and footpaths, the car remains king. Some elements of Transit City and Walking City but not enough.

- Frankland Springs LN – Brighton
- Beaumaris
- Landsdale Gdns
Rebuilding the Transit City while the traffic engineers still reigned....

Then extending the Transit City into the Auto City....

<table>
<thead>
<tr>
<th>Year</th>
<th>Route Km</th>
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<tbody>
<tr>
<td>1982</td>
<td>42km</td>
</tr>
<tr>
<td>1983</td>
<td>63km</td>
</tr>
<tr>
<td>1993</td>
<td>92km</td>
</tr>
<tr>
<td>2004</td>
<td>96km</td>
</tr>
<tr>
<td>2005</td>
<td>100km</td>
</tr>
<tr>
<td>2006</td>
<td>172km</td>
</tr>
<tr>
<td></td>
<td>54 kms within freeway median</td>
</tr>
<tr>
<td>Total</td>
<td>172km</td>
</tr>
</tbody>
</table>
National and global model...

$17-22 \text{ mill per km.} \ 78,000 \text{ passengers a day, 16\% growth in past year!}$

But respects the Auto City still...

Carrying 8 lanes of traffic.
Helps rebuild the Walking City...
New Central Station under government building....

Next development over the sunken rail line
Esplanade Station

New Perth waterfront TOD
Respecting the old inner city fabric... Now we know density can look good..

Even in the outer suburbs...
Public transport election....
The Ring Rail, LRT and BRT plus development sites for the next 30 years growth in Perth... regenerating all 3 fabrics
The economics of regenerating the three urban fabrics....

- Double then triple the transit patronage.
- Reduce the sprawl – potentially to zero.
- Save $3.9b in residential infrastructure costs.
- Save 1.14b T of greenhouse gases per year (50% less per household).
- Save $2.6b in transport costs for new residents over 50 years.
- Save health costs and improve worker productivity by $403m per year.

Knowledge-city light rail...
Tram land use...

Rebuilding Auto City as a Smart Sustainable City with real centres
Why we must regenerate the three urban fabrics.....

Arctic sea ice extent 1978-2007
in millions of km2
(National Snow and Ice Data Center)
Signs of hope......
Peak Car Use - US cities...

- Declining in **car use** – 4.3% in past year, plateau over the past 5 years.
- Increasing **transit use** – 6.5% in past year.
- Cities coming back in.

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### Per Capita Private Travel by City

- **Source**: BTRE (2011): Australian Infrastructure Statistics Yearbook

- **Graph** showing the per capita private travel by city, with data spanning from 2005 to 2012, indicating trends in travel by year.
Annual vehicle miles per driver by age, USA, 1995, 2001, 2009
History of innovation and transport....

Next: Sustainable transport....
‘Cars are so yesterday: young and rich leave guzzlers behind’

From 2001 to 2009, car use by 16 to 34 year olds decreased from 10,300 miles to 7900 miles per capita – a drop of 23 per cent.

And increased:

- Public transit 100%
- Biking 122%, and
- Walking by 37%

MOSTLY MOVING BACK INTO CITIES
Sydney is coming back in after a century of going out

Is a New urban form emerging?
THE POLYCENTRIC CITY

Households living within a TOD are smaller, same age and same income as rest of US but own fewer cars (0.9 cf 1.6) and have 20% of income freed due to less costs for transportation.

Centre for Transit Oriented Development, Reconnecting America.