Sustainable Transport Toolbox

By
Peter Newman
Professor of City Policy
Murdoch University,
Perth, Australia.
Fulbright Fellow, UVA.

and
Mark Bachels
Sustainable
Community
Development,
Parsons Brinkerhoff
Sunshine Coast,
Australia.
The Hobo-Dyer Equal Area Projection

This new map belongs to the family of Cylindrical Equal Area projections in which the latitude and longitude lines form a rectangular grid. Other projections in this family include the Lambert, Gall, Behrmann, Edwards, and Peters projections. In the present case the "cylinder" is assumed to wrap round the globe and cut through it at $37^{1/2}$° north and south. In order to preserve the equal area property the shapes of the landmasses become progressively flattened towards the poles, but shapes between $46^{1/2}$° north and south are well preserved.
Sustainable Transport Toolbox

1. Using good data.
2. Arguing the case for rail, especially its good politics.
3. Engaging the Public.
4. How dense to make the centre work?
5. Creating great public spaces and sustainable streets to support transit.
6. Including other green innovations.
Using good data...

- Especially ours....
Data are from a comparative study of 100 global cities and involved 27 parameters using highly controlled processes to ensure comparability of data.

The study took 5 years and builds on previous data collection since 1980. The 2005 data collection will commence shortly.

Some data on the cities can be viewed on www.sustainability.murdoch.edu.au

16 cities were incomplete so mostly the data are of 84 cities.
Urban Density, 1995 (Persons/Ha)

Cities

- American
- Australia/New Zealand
- Canadian
- Western European
- High Income Asian
- Eastern European
- Middle Eastern
- African
- Low Income Asian
- Latin American
- Chinese
Proportion of Total Motorised Passenger Kilometres on Public Transport, 1995
Rail revolution....

- Big old cities are renewing their rail systems, eg London, Chicago, New York...
- Small European cities are building light rail, eg German cities, Copenhagen,
- ‘New world’ car dependent cities are putting in rail, eg all Australian cities (after Perth), 100 US cities...
- Third world cities are doing a mixture of rail and BRT, including Chinese cities.
Curitiba: the Brazilian city which left the third world through urban planning.
Boulder: bioregional and local community strategic planning. Now the US ‘most desired city’ to live in.
Local bus network free upon purchase of Eco-Pass. New rail to Denver being built and the city is creating a new TOD centre on an old car yard.
Sustainability Criteria Spidergram for Sydney’s New Land Release Program
Visionary and transformative rail project...
Links new land release areas to the ‘global arc’ new economy areas.
US rail revolution…

- 2000-2005 70% of transit ballot initiatives successful in 33 states (cf 34% in other initiatives), 80% in 04/05.
- This is over $70 billion for 200 projects.

Centre for Transit Oriented Development and Reconnecting America.
ARGUING THE CASE…
How does good transit benefit cities?

1. By reducing the proportion of wealth spent on transport.
2. By reducing the external costs of transport.
3. By saving time.
4. By saving space.
5. By creating city spaces suitable for the ‘global knowledge/services economy’.
6. By creating certainty for investment.
7. By good politics.
1. By reducing the proportion of wealth spent on transport.

Car dependence is expensive.
The cost of transport 1990
(Total operating cost of passenger transport)

[% of GRP]

US Cities: 12.4
Australian Cities: 13.2
Toronto: 7.4
European Cities: 8.1
Wealthy Asian Cities: 4.8
Developing Asian Cities: 15.9

Sustainable Urban Transport Systems Project - IST
©1997 Felix Laube
### Strong Rail Versus Weak Rail Cities: Economic Indicators

<table>
<thead>
<tr>
<th>Metric</th>
<th>Strong Rail Cities</th>
<th>Weak Rail Cities</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRP Per Capita ($US, 1990)</td>
<td>$29,493</td>
<td>$20,352</td>
<td>45% More Wealthy</td>
</tr>
<tr>
<td>% of GRP Spent On Operating Pass. Transport</td>
<td>9%</td>
<td>13%</td>
<td>2/3 The Wealth On Transport</td>
</tr>
<tr>
<td>Road Expenditure Per $1,000 of GRP</td>
<td>$5.96</td>
<td>$9.07</td>
<td>34% Less Road Expenditure</td>
</tr>
<tr>
<td>Transit Cost Recovery</td>
<td>53%</td>
<td>51%</td>
<td>4% More Cost-Effective</td>
</tr>
</tbody>
</table>

The costs of car dependence in Australia

The transport poor are now living on the fringes and on the coast....some families use 40% of their income on transport.

Saving one car in a family is equivalent to saving $0.75m in superannuation.
Costs of transport in US

- The proportion of household expenditure spent on transportation has risen from 10% in 1960’s to 19% in 2005.

- Cities with the highest car dependence have the highest proportion (Houston, Detroit) and those with the best transit have the lowest proportion (New York, Portland).

‘Driven to Spend’ STPP, 2005.
The TOD market in the US...

1. Demand to live within half a mile of a rail system (existing and planned) is 14.6 million households (double number living there now).

2. Households living now 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.
2. By reducing the external costs of transport.

Car dependence is very costly.
MULTIPLE SUSTAINABILITY PROBLEMS OF AUTOMOBILE DEPENDENCE

<table>
<thead>
<tr>
<th>ENVIRONMENTAL</th>
<th>ECONOMIC</th>
<th>SOCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil vulnerability</td>
<td>Highway costs</td>
<td>Loss of community</td>
</tr>
<tr>
<td>Smog and CO2</td>
<td>Sprawl costs</td>
<td>Loss of safety</td>
</tr>
<tr>
<td>Traffic impacts</td>
<td>External costs</td>
<td>Equity issues</td>
</tr>
<tr>
<td>Sprawl into rural land</td>
<td>Loss of land</td>
<td>Accessibility loss</td>
</tr>
<tr>
<td>Stormwater</td>
<td>High running costs</td>
<td>Social network loss</td>
</tr>
</tbody>
</table>

WHAT ABOUT HEALTH?
IF A CITY USES ALL ITS TRAVEL TIME BUDGET IN AUTOMOBILES WITH NO WALKING TIME LEFT THEN IT WILL DEVELOP HEALTH PROBLEMS RELATED TO OBESITY AND LACK OF IDENTITY.
Transport CO₂ emissions per capita 1990

- US Cities: 4536 kg/person
- Australian Cities: 2789 kg/person
- Toronto: 2434 kg/person
- European Cities: 1888 kg/person
- Wealthy Asian Cities: 1158 kg/person
- Developing Asian Cities: 837 kg/person

Public transport portion of emissions

Sustainable Urban Transport Systems Project (SUTP)
Transport deaths per 100,000 people 1990

- US Cities: 14.6
- Australian Cities: 12.0
- Toronto: 6.5
- European Cities: 8.8
- Wealthy Asian Cities: 6.6
- Developing Asian Cities: 13.7

Sustainable Urban Transport Systems Project - ISTP
©1997 Felix Laube
“We’ve embarked on the beginning of the Last Days of the Age of Oil”
Mike Bowlin, CEO of ARCO 1999
Transport must move to local energy sources
-electric and gas.
ACTIVITY INTENSITY VERSUS PRIVATE CAR TRAVEL IN 5 HIGHER INCOME CITIES

\[ y = 105866x^{0.6612} \]

\[ R^2 = 0.8165 \]
PER CAPITA PASSENGER TRANSPORT ENERGY USE VERSUS ACTIVITY INTENSITY IN SYDNEY LGAs, 1981

\[ y = 58290x^{-0.285} \]

\[ R^2 = 0.6368 \]
Activity Intensity and Transport Energy

Sydney 2000

$R^2 = 0.6973$
Hope in a time of oil-derived terrorism...?
3. By saving time.

Time savings drive city infrastructure and planning.
Transit and car speeds and their ratio
1990

<table>
<thead>
<tr>
<th>Location</th>
<th>Transit (km/h)</th>
<th>Cars (km/h)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Cities</td>
<td>49</td>
<td>28</td>
<td>1.75</td>
</tr>
<tr>
<td>Australian Cities</td>
<td>46</td>
<td>31</td>
<td>1.51</td>
</tr>
<tr>
<td>Canadian Cities</td>
<td>42</td>
<td>25</td>
<td>1.68</td>
</tr>
<tr>
<td>European Cities</td>
<td>39</td>
<td>34</td>
<td>1.15</td>
</tr>
<tr>
<td>Wealthy Asian Cities</td>
<td>34</td>
<td>31</td>
<td>1.09</td>
</tr>
<tr>
<td>Developing Asian Cities</td>
<td>26</td>
<td>19</td>
<td>1.37</td>
</tr>
</tbody>
</table>

Sustainable Urban Transport Systems Project - ISTP

'1996 Felix Laube
How transport 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’…. And people will use the modes that keep them in that budget.
TRADITIONAL WALKING CITY

Up To 1850 In Europe

- High Density
- Mixed Use
- Organic Structure
TRANSIT

CITY

1850 - 1940 dominant city form in industrial world

- Medium Density
- Mixed Use
- Grid Based
- Centralised

Tram

Suburbs

Rail Based

Suburbs
AUTOMOBILE CITY
1940 - Present, US + Australian Cities Mostly

- Low Density
- Separated uses
- Arterial Grid and cul de sac Based
- Decentralised

Ex-urban or Special Rural

Industrial Uses

Middle Suburb - grid based

Post 60's Residential Cul De Sacs

Industrial Uses
Bossley Park
CITY LIMITS.....

The Marchetti constant means that when a city grows beyond its ‘one hour wide’ size it will begin to become dysfunctional....depending on its average speed and its density.

Auto dependent cities are seeing these limits earlier than other cities. Result: road rage, anti-sprawl movements, market-based re-urbanisation especially TOD, 100 new rail projects across the US....
FUTURE CITY
- NODAL/INFORMATION CITY

- Mixed Density- high, medium & low.
  High - urban villages.
  Medium - 800m around transit stops.
  Low - DRT or cycle distance to transit.
- Integrated - residential, commercial, small scale industry.
- Sub-centralised - link by transit and telecommunications.
Marchetti is forcing us into a new city form based on centres and public transport - re-creating a series of Transit Cities within the region.

It is also assisted by the new global city economy which is a concentrating force....
Centres and corridors...

- **Sydney Metropolitan Strategy**
Model of the city showing centres and corridors
Joyce-Collingwood Station Precinct: An example of the kind of centres required around transit to reduce car dependence. These are contemporary “walking cities” linked to transit.
4. By saving space.

2,500 people/hr - Freeway lane.
8,000 people/hr - Bus lane.
10-20,000 people/hr - LRT line
50,000 people/hr - Train line.
240 Persons travel to work:

-- in 177 Cars

-- in 3 Busses

-- in 1 Tram
If Sydney removed its train to the CBD...

You would need:
• 65 lanes of freeway
• 782 ha of car parks, or 1042 floors of multi-storey car park.

In reality business would scatter as in other car dependent cities.
⑤-1 Cheonggyecheon Area before Restoration

(http://www.metro.seoul.kr/kor2000/chungaehome/en/seoul/2sub.htm/)
6-1 Cheonggyecheon Area after Restoration

The re-opening of Aarhus River 1996 - 1998
People for Public Spaces:

- ‘Think of transportation as public space...’ David Burwell
- ‘Road engineers are realising they are in the community development business not just the facilities development business’. Andy Wiley-Schwartz.
- ‘The slow road movement’.
5. By creating city spaces suitable for the ‘global knowledge/services economy’.

People in cities need to meet. Cities with the best meeting spaces are winning the global city jobs.
“The new world will largely depend, as the old world did, on human creativity; and creativity flourishes where people come together face-to-face.”

(Peter Hall, 1997, p89)
6. By creating certainty for investment.

Rail is fixed - mostly.
So, can do Transit Oriented Development.
What is Transit-Oriented Development doing for US cities?

- Increased retail yields due to higher levels of pedestrian traffic on streets
- Increased land value due to amenity of train station
- Reduced vehicle ownership
- Tool to achieve Smart Growth
- Better regional air quality
- Reduced dependence on cars and fossil fuels
- More housing options.

‘Reconnecting America’ 2003
What is Transit-Oriented Development doing for US cities?

“Over 30 ‘hedonic regression model’ studies from across the United States have proven land value premiums due to station accessibility.”

Robert Cervero, 2003
State Centre TOD, PB Placemaking
7. Transit is good politics.

People want to see long term visionary thinking from politicians
OVERCOMING AUTOMOBILE DEPENDENCE IN ASIAN CITIES

Supplementary policies on traffic demand management, parking restrictions, congestion taxes... can all help, but will be reduced to marginal exercises unless the structure of the city is addressed in terms of the relative speed of traffic compared to sustainable transport modes.
Growth in Perth versus Adelaide Rail Patronage

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Passenger Boardings (000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>774.0</td>
</tr>
<tr>
<td>1992</td>
<td>820.0</td>
</tr>
<tr>
<td>1993</td>
<td>965.0</td>
</tr>
<tr>
<td>1994</td>
<td>14225.0</td>
</tr>
<tr>
<td>1995</td>
<td>22302.0</td>
</tr>
<tr>
<td>1996</td>
<td>24040.0</td>
</tr>
<tr>
<td>1997</td>
<td>27900.0</td>
</tr>
</tbody>
</table>

Perth

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Passenger Boardings (000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>615.0</td>
</tr>
<tr>
<td>1992</td>
<td>7010.0</td>
</tr>
<tr>
<td>1993</td>
<td>7540.0</td>
</tr>
<tr>
<td>1994</td>
<td>827.0</td>
</tr>
<tr>
<td>1995</td>
<td>8273.0</td>
</tr>
<tr>
<td>1996</td>
<td>8276.0</td>
</tr>
<tr>
<td>1997</td>
<td>8165.0</td>
</tr>
</tbody>
</table>
New southern line will complete 180 kms of electric rail with 72 stations in 20 years.
Perth rail revival...

- Associated with four election victories for the ALP
- In 2005 election the ‘train’ was the number 1 positive associated with the ALP.
- Rail system improvements are seen as long term visionary planning.
- They also provide the market for TOD’s...
Subi-Centro Urban Village, Subiaco railway station, Perth - a “walking city” environment
Perth TOD Strategy now to optimise rail investment. Sydney investor has raised $90m to invest in TOD in Perth as he can make more money there than anywhere else. (Adds an extra 15% minimum to any profit he can make.)
Lifestyle Complex
Coming Soon.

Register your interest today.
Call 9419 6222 or visit
www.thevillageatwellard.com.au
Department of Transport, Perth

(Telephone Survey, 400 people)

Need for Public Transport/Cycle/Walking Over Car Use

- Very large need: 40%
- Large need: 38%
- Moderate need: 19%
- Low need: 2%
- No need at all: 2%
Department of Transport, Perth

(Telephone Survey, 400 people)

Use Road Funding to Pay for Public Transport, Cycling and Walking

- 87% Supportive
- 13% Neutral or Not Supportive
Politics is everything...
Participatory engagement techniques...

- **21st Century Town Meetings.** For strategy direction. Key: 1/3rd non-aligned citizens.
- **Charettes.** For details of TODs on the ground. Breaks traffic engineers mould.
- **Citizens Juries.** For contentious issues.
- **MCA Workshops.** For siting choices.

[www.21stcenturydialogue.com](http://www.21stcenturydialogue.com)
How dense to make centres viable?
Activity Intensity and Transport Energy
Sydney 2000

R² = 0.6973
35 people and jobs per ha is how traditional transit cities were built and how the best TOD’s are today.

Means 10,000 people and jobs within 1km radius of the centre
100 people and jobs per ha is how traditional walking cities were and how strong walkable centres are today.

Means 100,000 people and jobs within 1 km of centre.
Chicago the US city with most population growth...
Making good public spaces and sustainable streets...to go with the transit
Reclaiming the North American city from car dependence…

- Canadian cities like Toronto led the way in 1960’s and 70’s showing that freeways weren’t needed and *good transit with good public spaces was.*
- Portland showed it was possible in the US.
- Most US cities now pursuing less car dependence …
- Vancouver has shown something special…
City of Vancouver
30,000 fewer car trips per day
100,000 more walk/cycle trips per day
15 to 30% in 15 years.
How?

Mostly by high rise residential estates attractive to families.
How is this done? High density but good street level design...

- Requiring 5% of the value of a development to be social infrastructure... landscaped open space, public art, community centres, schools, arts facilities...
An example
Coal Harbour
Rail can be very powerful in influencing the form and scale of development.
Copenhagen’s new Metro
Built from land development in TOD’s
In new areas not yet at 35 people and jobs per ha...and not yet with good streets and public spaces.
So it needs lots of car park...
How to include transit with other green innovations.

- ‘Resilient, sustainable, solar cities’ require all the green innovations as well as the transit/walking links.
- Few examples exist of all being integrated. Vaubun the best...
Kogarah Town Centre – an Eco-TOD
Water System Design
Christie Walk Eco-Village, Adelaide. Strawbale apartments in central city; grey water to permaculture gardens; PV; no parking.
Vaubun Freiburg Eco-village with car-free housing.
The new ‘resilient, sustainable, solar city’ demonstrations will be the global leaders in innovation.