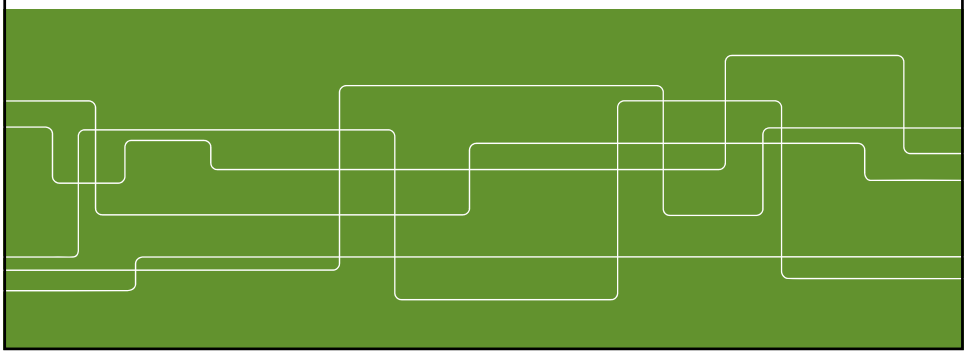
Land Use, the Built Environment and Travel

2015-04-21



Part 1

MOTIVATION FOR LOOKING AT LAND USE/BUILT ENVIRONMENT

Planning for Sustainability

Transport is a major source of

- Fossil fuel consumption
- Air pollutants contributing to poor air quality and global warming

Is technological change enough to address these problems?

- Alternative energy sources
- Reduced vehicle emissions

Or, must travel behavior change, to reach our goals?

Planning for Sustainability

Can we plan cities such that less travel is required?

Possibly – *if* travel is affected by the way we plan cities.

Let's set some goals:

- Reduce use of private motor vehicles…
- …by shifting trips to walking, cycling, and public transport use

Features of the Built Environment

Local
Roadway Design
Walking and Cycling Conditions
Building types, setbacks

Regional
Density
Land Use Mix
Accessibility to Destinations
Network Connectivity

The "D"s of the Built Environment

The Three D's:

1. **D**esign
2. **D**ensity
3. **D**iversity

1. Design: Roadways

Four Lanes w/o center turn lanes

center turn lanes, bike lanes, ped refuge island at bus stop

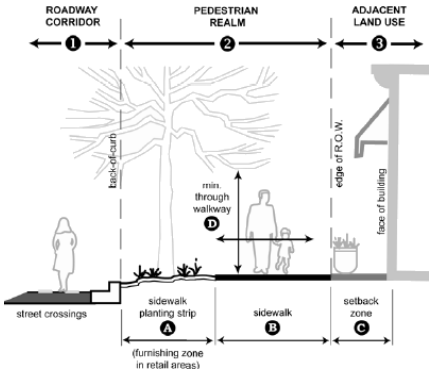
Litman, 2013

1. Design: Walking and Cycling Conditions

“Bad”

Streetsblog

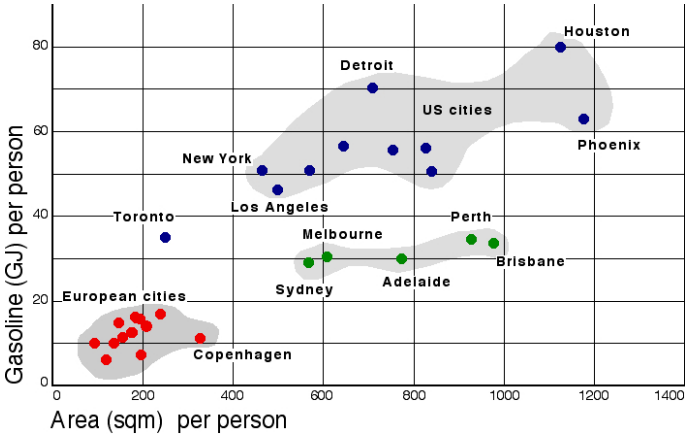
“Good”



City of Redmond, WA

Woonerf

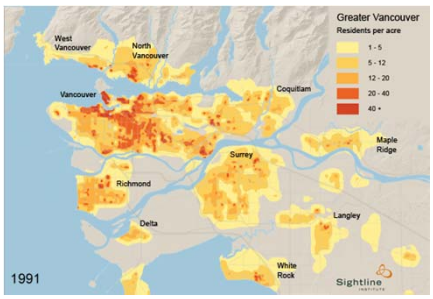
2. Density



Newman & Kenworthy 1989

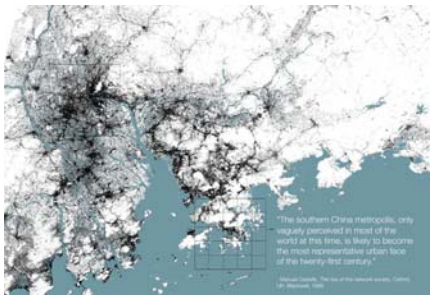
2. Density

Vancouver



Sightline Inst., 2013

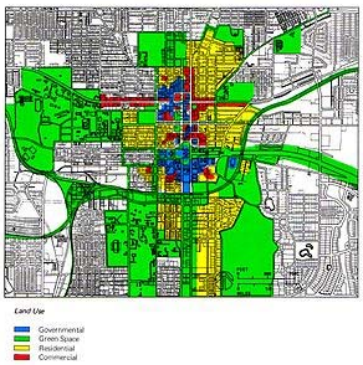
Guangzhou – Hong Kong



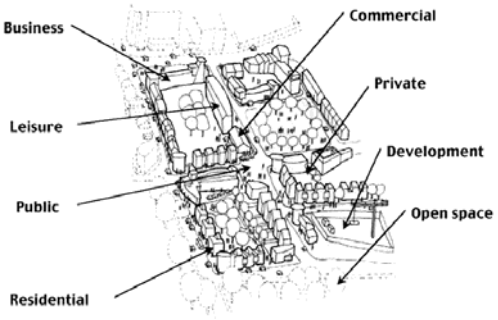
Blackwell, 1996

3. Diversity: Land Use Mix

Segregated



Mixed



Kent County (UK) Design Guide

3. Diversity: Land Use Mix

Entropy Indices

- Measure of "disorderliness" in separation of land uses; higher is more mixed

Dissimilarity Indices

- Measure of difference between uses in neighbouring parcels

"Completeness"

- Measure of whether a full set of essential services exist in a neighbourhood

Jobs-Housing Balance

- Measure of how well the number of labourers matches the number of jobs in a neighborhood

The "D"s of the Built Environment

The Three D's:

1. **D**esign
2. **D**ensity
3. **D**iversity

For the Five D's, add:

4. **D**estination Accessibility
5. **D**istance to Transit

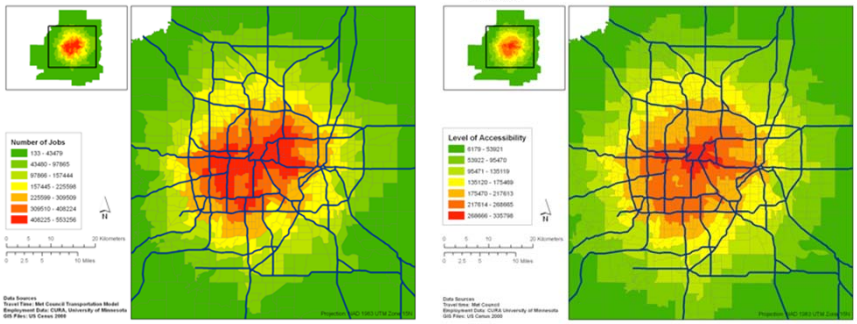
4. Destinations: Accessibility Measures

Cumulative Opportunities

- E.g. # Jobs within 10 minutes by car in morning

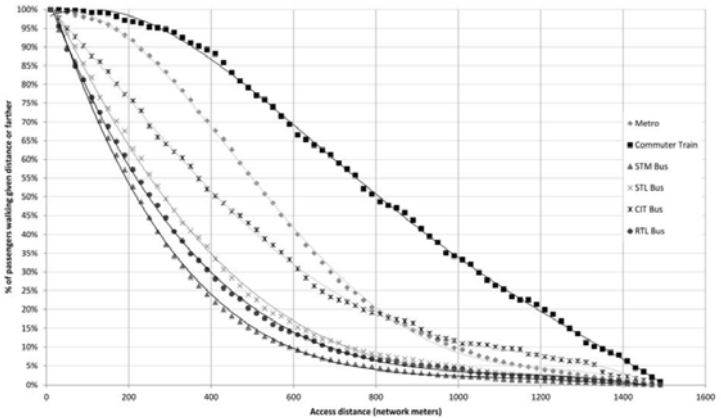
Gravity-Based

- Weighted sum of jobs in region, with weights based on travel time



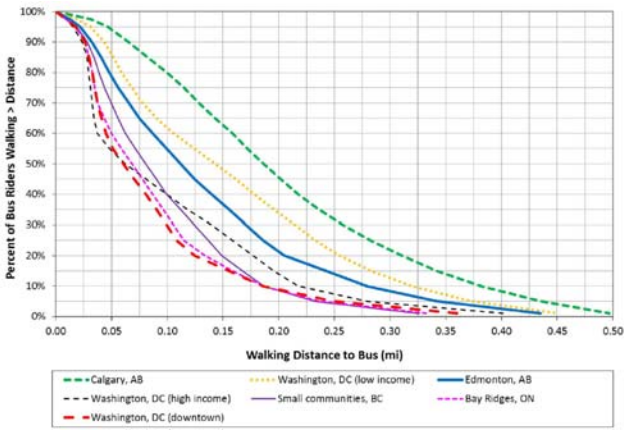
Levinson & El-Geneidy 2006

5. Distance to Transit – by Type of Service



El-Geneidy et al, 2013

5. Distance to Transit – by City



TRB, Transit Capacity and Quality of Service Manual, 2013

The "D"s of the Built Environment

The Three D's:

1. **D**esign
2. **D**ensity
3. **D**iversity

The Five D's, add:

4. **D**estination Accessibility
5. **D**istance to Transit

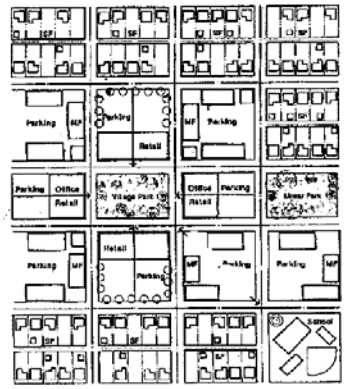
And Sometimes:

6. **D**irectness of Network
7. **D**emand Management

6. Directness of Network

Hierarchical Road System

Connected Road System

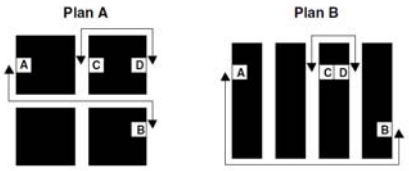


Kulash et al 1990

6. Directness of Network

- Road or Intersection Density
- Proportion 4-way Intersections vs. Other Intersections
- Proportion Dead-End Streets

Block Size & Length



Dill 2005

7. Demand Management

- Employee trip-reduction
- Ridesharing programs
- Congestion-based pricing
  - Roads
  - Parking

Group Exercise

1. Form a group of 2, **with a classmate you don't know very well.**
2. Choose one of the "D"s.
3. Discuss the following questions:
   - What strategies could be taken to support this "D", in:
     - Newly developed areas?
     - Already built-up areas?
   - What actors could implement these strategies?
   - What trade-offs would be required?

Part 2

EFFECTS OF LAND USE ON TRAVEL DEMAND

Possible Effects on Travel

Travel Choices

- Total number of trips
- Trip consolidation/chaining
- Travel mode
- Destination choice

Other Related Choices

- Automobile Ownership
- Bicycle Ownership
- Long-Term Public Transport Pass
- Participation in Ridesharing Systems
- Membership in Car Sharing Clubs
- Home location

Three degrees of evidence

1. Aggregate Association
2. Disaggregate Association
3. Causality

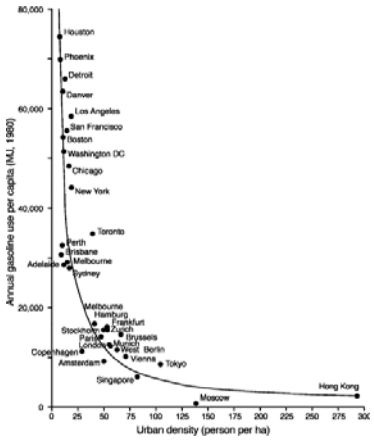
Increasing Strength of Evidence

1. Aggregate Association

Energy Use per Capita
vs.
City Population Density
Newman & Kenworthy (1989)

Vulnerable to the "**Ecological Fallacy**": correlation of aggregate groups does not imply correlation for the groups' members

I.e.: Correlation across cities does *not* imply a single city would follow the same curve.



1. Aggregate Association

Newman & Kenworthy (2006) →

Holzclaw (1990)

- Least dense SF neighbourhoods: 5x the travel compared to least dense neighbourhoods

LUTRAQ (1993)

- High Ped. Env. Factor: lower travel than Low PEF

2. Disaggregate Association

Measured individual behaviours:

- Number of trips
- Distance travelled
- Mode choice

Explanatory Variables:

- Mixed Uses
- Density
- Walkability
- Socio-Economics & Demographics (SED)
- Attitudes

2. Disaggregate Association

Hanson (1982), Uppsala:

- Higher densities → higher trip frequencies
- Many destinations → shorter shopping trips, but longer other trips

Handy (1996):

- Greater accessibility → more non-work trips
- Built form more important than SEDs

Cervero & Kockelman (1997)

- Urban form → mode choice, distance traveled
- But, SEDs more important

Kitamura et al (1994):

- SEDs and Attitudes more important than built form

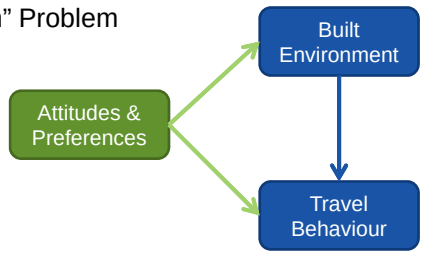
Kockelman (1997); Ewing & Cervero (2010):

- Accessibility → distance travelled

2. Disaggregate Association

But:
Correlation does not imply Causality

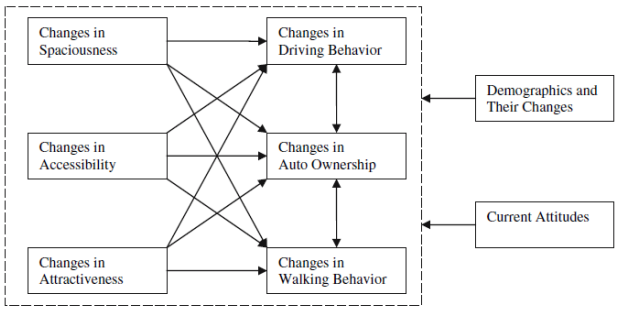
The "Self-Selection" Problem



3. Causality

Neighbourhood Characteristics, Travel Behaviour, and Attitudes
Cao et al (2007)

Approach: Structural Equation Modelling (SEM)



3. Causality

Neighbourhood Characteristics, Travel Behaviour, and Attitudes
Cao et al (2007)

Residential Self-Selection has significant effects on travel:

- Directly and indirectly via residential location choice

Still, built environment is associated with travel behaviour

- Accessibility
- Neighbourhood attractiveness
- Walk/Bike/Transit Options
- Safety
- Socializing

Part 3

URBAN FORM STRATEGIES FOR TRAVEL-EFFICIENT CITIES

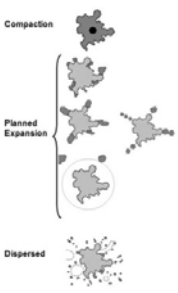
Planning for Density

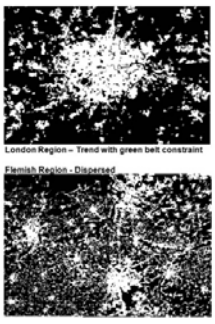
"Compact Cities" should theoretically lead to:

- Shorter trip distances overall
- Easier shifts to non-motorized & public transport

However, if we build denser cities

- People may move away from them, preferring less density
- People may travel just as far, and thus more trips are made in the same area → more congestion





Echenique et al 2012

Planning for Mixed Uses

Traditional “Zoning”:

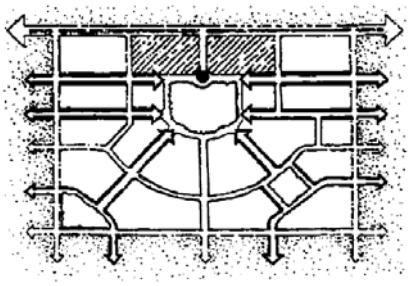
- Industrial vs. Residential
- Retail, Government
- High- and Low-Density Residential

City of Crystal Lake, IL

Planning for Mixed-Uses

Deliberate mixing of compatible land uses

- *Theory:* with mixed uses, a typical trip chain should require less distance:
  - Home-Work-Shopping-Home
- Physical Attractiveness of the development is essential
- Still, could lead to *increased* travel



Crane 1998

Priority to Public Transport & Non-Motorized Modes

Reallocation of physical street space:

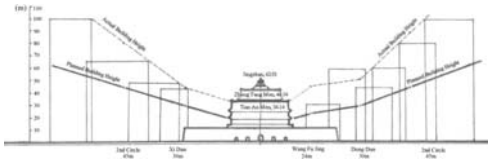
- Bus lanes
- Bicycle lanes
- Expanded sidewalks with amenities

Reallocation of signal cycles:

- Bus priority
- All-walk signal phases
- Bicycle signals

Removing Regulations

- Zoning Laws
- Density Limits & Height Restrictions
- Parking Minimums
- Street Width Minimums



What's the Next Step?

Assessing the effectiveness of sustainable transport policies in the long-run

Readings:

- Spiekermann & Wegener, 2003, "Modelling Urban Sustainability", in *Int'l J. of Urban Sciences*
- Echenique et al, 2012, "Growing Cities Sustainably", in *J. of the American Planning Association*

Also:

- Bring draft of Assignment 2