

“Models” of the Metropolis

Day 3
11.953

Content

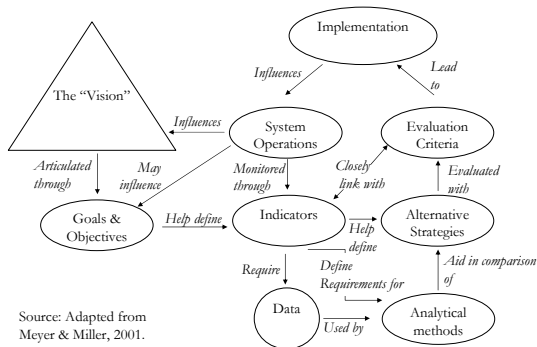
- Wrap-up from Last Lecture
- Models of Cities?
- “Normative” Models
- “Positive” Models
- Functional Models
- Implications for Us

Towards Measurement

Indicators in Transportation

- Traditional Indicators: Level of Service (LOS)
- Newer Indicators: related to the “paradigm shift” in transportation (e.g., Ewing, 1995)
 - Vehicle Hours of Travel (VHT)
- Perspective Dependent (Litman, 2003):
 1. Traffic-based: vehicle trips, traffic speed, roadway LOS;
 2. Mobility-based: person-miles, door-to-door travel time
 3. Accessibility-based: person-trips, generalized travel costs.

“Performance-Based” Planning & Decision Making



What do we want from our Metropolises' LUT system?

Measures to be Increased

- Accessibility
- Equity of accessibility
- Appropriate mobility infrastructure

Measures to be Reduced

- Congestion
- “Conventional” emissions
- Greenhouse gas emissions
- Noise
- Other environmental impacts
- Community disruption
- Accidents
- Non-renewable energy demand
- Transport-related solid waste

Modified from WBCSD, 2001

What do we mean by “models”?

- A representation of structure, and related senses.
- A set of designs for building/structure, plan of town, garden, etc.
- Something which accurately resembles or represents something else
- An archetypal image or pattern
- A simplified or idealized description or conception of a particular system/process, often in mathematical terms, proposed as a basis for theoretical or empirical understanding, or for calculations, predictions, etc.;
- A conceptual or mental representation of something
- A set of entities that satisfies all the formulae of a given formal or axiomatic system.

Derived from: Oxford English Dictionary (OED.com)

Models = Theories?

- Positive
 - “objective”
- Normative
 - “subjective”

“Models” of City in Time

- Does the city itself represent a “model” of underlying social, cultural, economic system of its time?
 - e.g., Lynch’s idea of the “cosmic city”
 - The artistic (or artistic-religious) city (e.g., the “Renaissance”)
 - Economic city (industrialist, capitalist, socialist)
 - Philosophical city (the “utopian”)

“Modern” Models of the City

Late 1800s-Early 1900s

- Rapid intellectual developments in various fields
 - Sciences: e.g., Darwinism in biology, Relativity
 - Technologies: e.g. internal combustion engine, telecommunications
 - Management: e.g., the assembly line and “science of management”
 - Public policy: social sciences)
 - Philosophy: e.g., logical positivism
 - The arts/design: e.g., modernism
- Convergence, integration of above also lead to new disciplines
 - Including urban planning
- Broader (and inter-related) dynamics
 - Urbanization, industrialization, demographics (longevity)
 - Increasing pressures to settle and house ever-larger urban populations and economic activities

The Garden City “Model”

A Normative Model for the City

- Howard, Unwin, Barnett, Parker, Wright, Stein
- Explicit response to social/environmental conditions
 - The city as social reform
 - In practice, middle class from the start
 - Linked to company towns (“Co-Partnerships”)
- Widely propagandized
 - books, Garden Cities and Town Planning Association, AIA Journal, etc.

The Garden City “Model”

- Adopted by UK and US governments to meet war-time housing needs
- Characterized by cul-de-sacs, lower densities, greenspaces
- In US appears in Yorkshp Village (1918) and Radburn (begun 1929)
- Radburn: “garden city for the motor age”
 - First large scale “Garden City” adaptation to the U.S.
 - Aimed to promote pedestrian travel while accommodating rapidly growing automobile usage
- Radburn pedestrian-oriented design principles largely lost in subsequent mass adaptation
- Garden City genes can be found in “new community” movement (1960s) (e.g., Colombia, MD), “urban villages” (1980s), and today’s “new urbanism”

The Modernist “Model”

- Le Corbusier, the “city as machine”
- The CIAM’s (Congres Internationaux d’Architecture Moderne) “Athens Charter” (1933)
 - the “Functional City”
 - Efficiency: e.g., limited access highways
 - Simplicity in design
 - Separation of uses: e.g., single use zoning
 - Streets exclusively for traffic
 - City as *tabula rasa*

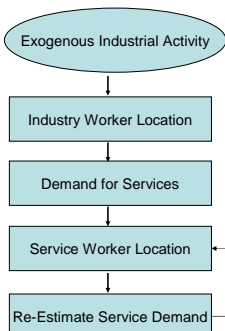
The Modernist “Model”

- Social order = f (built space)
 - Functionality’s pre-eminence
- Shared the same social goals as “garden city”
- In practice, Le Corbusier’s “radiant city”/“city as machine” would be combined with aspects of the “garden city”/“garden suburb”
 - Combination facilitated the predominant patterns of urban and suburban development

“Positive” Models of the City

Burgess (1928)

Urban Growth is Process of Expansion & Reconversion



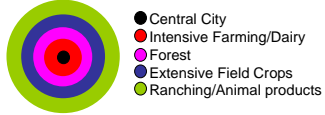
“Positive” Models of the City

Lowry (1964)

- One of the first *operational* land use-transportation models
- Gravity models of friction (work trips)
- “Multipliers” determine number of workers
- Constrained by factors such as density
- Not an *economic* model, per se (e.g., no prices)

“Positive” Models of the City

- Most prominent *economic* models of the city derive from von Thünen (1826)
 - To explain farmer trade-off between land cost and transportation costs



- Re-discovered by Alonso (1964), Mills (1967), Muth (1969).
 - Commuter-distance/cost.
 - Related to *density gradients*

Tiebout

A public finance Model of location decision

- *But, a-spatial*
- 1. Force voter to reveal preferences for public goods
- 2. Provide for these preferences in the same way as a private goods market
- 3. Tax her accordingly

Public/Private Goods

		Exclusion from consumption	
		YES	NO
Competition for consumption (Rivalry)	YES	private good: e.g., food, clothing	common good: e.g., park-space
	NO	club good: private schools, sports clubs	public good: e.g., national security

Tiebout's "extreme model": Assumptions

1. Fully mobile consumer-voters
2. Full knowledge of revenues/expenditures
3. Large number of communities from which to choose
4. No restrictions due to employment opportunities
5. No spillovers across communities
6. An optimal community size for all service patterns exists
 - limited by land area
7. Communities below the optimum size seek to attract new residents to lower average cost.

Implications of Tiebout

- With fully mobile consumer-voters *and*
- Appropriate level of local governments *with*
- Set expenditure-revenue patterns *then*
- A "conceptual solution" to local public goods exists

- The higher the mobility costs (i.e., changing community), the less optimum the allocation of resources.

Limitations to Tiebout

Tiebout is a useful conceptual, positive model, but recognize limitations:

- Not clear how the initial options would be presented to voters;
- What if there are large numbers of public goods and highly varying tastes?
 - community size approaches the number of people;
- With large spillovers, arrive at non-optimal solutions

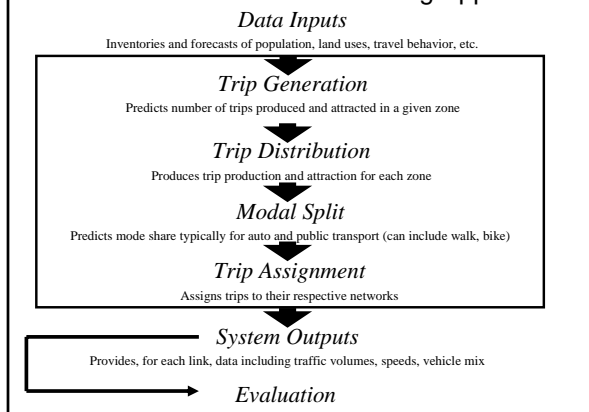
See Mueller, 1976.

Transportation & Land Use Models Today

- Remember, models are *abstractions* of reality
 - They can *never* be right
- Why model?
 1. *Rigor*. Requires specificity; can help understanding the system.
 2. *Comprehensiveness*. Large data handling capabilities; integration of different theories.
 3. *Logic*. Generally follow a clear logic, attempting to represent “real world” causality.
 4. *Accessibility*. In theory, transparent; others can examine/judge.
 5. *Flexibility*. Ability to explore a range of strategies.
- How do we model?

Derived, in part, from Meadows & Robinson, 1984.

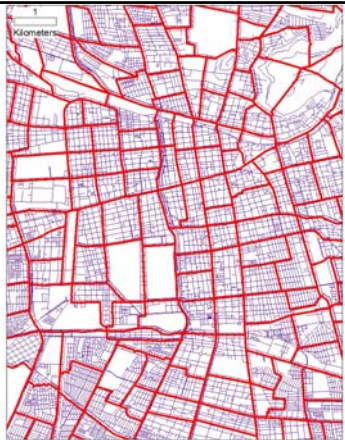
Conventional Travel Forecasting Approach



Traffic Analysis Zone (TAZ)



Traffic Analysis Zone (TAZ)



Travel Data

- **Household Surveys:** Household members, all modes of transport, leaving/arriving
 - To estimate trip generation and mode split models;
 - Provides information for trip distribution models.
- **Intercept Surveys – external cordons:** Trips crossing the study area border
 - To validate and expand HH data
- **Intercept Surveys – internal cordons (screen lines):**
 - measure trips by non-residents, verify household data
 - inputs to trip generation, trip distribution models.
- **Traffic and person counts:**
 - To validate the rest of the surveys.

Other Related Data

- Land-use data
 - Including employment levels, composition.
- Transport network data
 - route and service levels, road section capacities, etc.
- Information about the transport system
 - fares, frequency, terminal characteristics, etc.
- Information from special surveys
 - For example, on the elasticity of demand (stated preference surveys, other methods).

Range of Travel Demand Models Available Today

- Commercial packages: TP+, EMME/2, TRANSCAD, TRANPLAN, MINUTP, QRSII,
 - Range in cost, quality, complications....
 - TRANSCAD has fully integrated GIS and demand forecasting modeling capabilities
 - EMME/2 has Multimodal equilibrium
 - QRS provides comprehensive set of default parameter values, ease of use, simplistic
- Trade-offs inevitable, depends on needs, capabilities, data availability, etc.

Freight Models

- Vehicle-Based – follow the passenger approach (generation, distribution, assignment)
 - Examples: New Jersey statewide, Phoenix Metro Area
 - Generally only good for internal trips
- Commodity-Based – typically inter-city, based on commodity flows
 - Examples: Michigan statewide, Portland Region
 - Generally only good for external (long distance) trips
- Combined Models
 - Example: Los Angeles Regional
 - Most promising approach

Source: U. of Washington, et al., 2001.

Some Shortcomings & Criticisms

Theoretical Problems

- Each step quite simplified
- Home-to-work focus; difficulty in capturing chained trips
- Internal consistency among the four steps
 - i.e., generation affected by assignment;
 - iteration only partly fixes this;
 - direct demand models extremely complex.
- Land uses purely exogenous
- Little policy sensitivity: pricing, growth management, etc.

Some Shortcomings & Criticisms

Common Application Problems

- Historical definition of a trip
- Size of TAZs
- Treatment of non-motorized travel (NMT)
- Auto Ownership exogenous
- Data quality
- Lack of treatment of freight travel
- Disconnect between travel models and, e.g., emissions models

“What TAZ do you live in?”

