Module 2: Spatial Analysis and Urban Land Planning

The Spatial Structure of Cities: International Examples of the Interaction of Government, Topography and Markets

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Summary

- What are urban spatial structures?
- How do we define urban spatial structures?
- Why spatial structures matter?
- Is there a global trend in the evolution of urban spatial structures?
Section 1:
What are Urban Spatial Structures?
What are Urban Spatial Structures? (1)

- Cities have complex shapes which seem to escape classification, and in a certain way every city is unique.

- However, cities have a spatial structure which is not always visible from the ground but which appears when analyzing data.

- Many cities which appear very dissimilar from the ground share the same spatial structure.
What are Urban Spatial Structures? (2)

- Understanding the spatial organization of a city allow planners to
  - Predict the main directions of future development
  - Develop strategies which are compatible with the current spatial structure
  - Influence the evolution the current structure in a manner consistent with municipal objectives
Spatial organization could be described by 2 superimposed patterns:

- the spatial pattern of population distribution within the built up area and

- The pattern of population movement around the city during the day
Figure 1: Three dimensional views of population distributions in 7 cities represented at the same scale.

- Jakarta: 14,908,000 people, 2,942 km²
- Moscow: 8,543,000 people, 470 km²
- Shanghai: 7,397,000 people, 244 km²
- London: 6,626,000 people, 1,062 km²
- Paris: 7,877,000 people, 893 km²
- Berlin: 4,212,000 people, 1,176 km²
- New York: 10,752,000 people, 2,674 km²

Scale: 100,000 people
Section 2:
How do We Define and Measure Urban Spatial Structures?
How do We Define and Measure Urban Spatial Structures?

- We can define urban spatial structures using a number of indicators. We will only focus on 3 main indicators:
  - Land consumption (density)
  - Density profile
  - Degree of monocentricity (share of trips with central destination)
Land Consumption per Person (density)

- Average density is the most common spatial indicator.
- It is an indicator of land consumption, the higher the density the lower the consumption of land per person.
- To be meaningful, density should be equal to the city population divided by the built-up area.
- Density measured by dividing population by administrative area is not meaningful and do not allow cross cities comparisons.
Urban Densities (1)

- Average density in built-up area varies by several order of magnitude from city to city
- There are no “correct densities”
- Densities reflect the complex interaction of land markets, topography, and government action
- Land markets have a strong cultural components, densities are therefore very much linked to culture
Comparative average population densities in built-up areas in 48 metropolitan areas

**Built-up Densities around the world (figure 2)**

- **USA**: Los Angeles (22), Washington metro. (21), Houston (11), Atlanta (6), San Francisco (19), San Franc. Bay (16), Chicago (16), Portland (Oregon) (14).
- **Europe**: New York (38), Toulouse (40), Curitiba (54), Brasilia (55), Paris (88), Prague (171).
- **Asia**: Mumbai (Bombay) (389), Hong Kong (367), Shanghai (266), Seoul (262), Tianjin (230), Ahmedabad (143), Abidjan (134), Tehran (146), Jakarta Municip. (127).
- **Latin America**: Buenos Aires (66), Mexico City (96), Rio de Janeiro (102), Tunis (107), Singapore (121).
- **Africa**: Jabotabek (Jak. Metro) (51), Johannesburg (53), Marseille (53), Cracow (65), London (62), Budapest (63), Riga (64), Dakar (66), Dakar (66).

*Source: "Order Without Design" Alain Bertaud, 2003*
The built-up densities of figure 2 are showing the large variations in densities between cities (from 6 p/ha in Atlanta to nearly 400 p/ha in Mumbai).

All the cities shown on figure 2 are economically viable, large difference of densities are therefore compatible with viable economies and are manageable.
Urban Densities (3)

- Densities seem to be more related to regions than to income, implying that densities might have a strong cultural causality.

- The high densities in Asian cities have not been “planned” but occurred because of cultural preferences expressed through land markets.
Urban Densities in Chinese Cities

- Chinese cities, which had been developing without land markets for about 40 years. However, they have high densities because of:
  - the relative underinvestment in urban infrastructure and housing during the same period
  - cultural factors shared with other Asian cities

- Between 1947 and 1980 Chinese cities grew mostly through densification of pre-1947 built-up area

- Until about 1990 the dominant mode of transport in Chinese cities was the bicycle limiting the radius of city extension and therefore increasing density.
Urban Densities have Important Implications

- The following example compare the built up area of 2 cities Atlanta (USA) and Barcelona (Spain)

- The 2 cities have about the same population of 2.6 million (1990) but their density is very different:
  - Atlanta 6 p/ha
  - Barcelona 171 p/ha
Figure 3: The built-up area of Atlanta and Barcelona at the same scale.

Atlanta:
2.5 million people (1990)
4,280 km² (built-up area)

Barcelona:
2.8 million people (1990)
162 km² (built-up area)
Urban Densities have Important Implications: Atlanta vs. Barcelona

- Because of the difference of density, Atlanta’s built-up area is 28 time larger than Barcelona’s.
- As a consequence, the metro of Barcelona is only 99 km long and its stations are within walking distance to 60% of the population.
- By contrast, to provide the same service to the same number of people, Atlanta would have to develop 3400 km of metro track!
- The lowest the density, the more expensive it is to provide public transport.
Density Profile

- Average density is a crude indicator of urban structure.
- The way densities are distributed within the built up area provide better information about urban structure.
- In the graphs of Figure 4 built up densities in 9 cities are measured within each successive rings from the center to the periphery.
Figure 4: Comparative density profile between 9 cities in Asia, Europe and USA.
Urban Density Profile

- Urban density profiles of the cities shown on Figure 4 are unexpectedly similar for Asian and European cities.
- American cities profiles are following the same pattern of decreasing density from the center but are much flatter and much lower densities in the center than Asian and European cities.
- This common density profile has not been created by design but by a self organizing mechanism resulting of the interaction of markets, infrastructure and regulations.
Pattern of Daily Trips within the Built-up Area (1)

- Densities as shown by census data are densities during the night.
- During the day people are moving around the city and densities will keep changing with each hour of the day.
- The pattern of daily trips within the built up area can be monitored by traffic count and origin-destination surveys.
Figure 5: Schematic representation of trip patterns within a metropolitan area.

(a) The monocentric model

(b) The polycentric model: The urban village version

(c) The polycentric model: The random movement version

(d) The mono-polycentric model: Simultaneous radial and random movements
Pattern of Daily Trips within the Built-up Area (2)

- The pattern of daily trip follow one of the following pattern:
  - Monocentric model
  - Polycentric model, Urban village version (exist only in master plans not in reality)
  - The polycentric model, random movements version (common in North American cities)
  - The mixed mono-polycentric model (the more common)
No city is purely monocentric, few cities are perfectly polycentric (with no dominant center)

A city can be considered dominantly monocentric if more than 35% of all trips are to and from the central business district

Trips are only partially generated by jobs, many trips are for shopping, culture or entertainment

Asian and European cities tend to be more dominantly monocentric than American cities
Section 3:
Why Urban Spatial Structures Matter?
Why Urban Spatial Structure Matters?

- Existing spatial structures limit the choice of urban strategies, for instance:
  - low density dominantly polycentric cities cannot develop viable public transport system
  - High density dominantly monocentric cities cannot rely on private cars as the dominant mean of accessing the city center
  - High density monocentric cities tend to have higher housing costs and lower consumption of floor space than low density polycentric cities
Section 4:
Is There a Global Trend in the Evolution of Urban Spatial Structures?
Global Trends (1)

- Cities tend to become more polycentric when they develop and when income are increasing, allowing individual transport.
- Densities tend to decrease as income are increasing because people consume more floor space per capita.
- Services tend to take more space in the city center decreasing population densities.
Global Trends (2)

- Less trips are due to commuting to work and more trip to shopping, education and entertainment, as a consequence employment location become a poor predictor of trip patterns.
- Successful cities tend to maintain a prestigious city center containing high quality amenities while linking subcenters with rapid transit.
- Typically trip to and within the city center are made by public transport, while trips between suburbs use individual transport or small collective transports.
Conclusions

- Urban planners should analyze and monitor the evolution of the spatial structure of the city they are responsible to plan
- Planners should identify the type of urban structure which
  - Is compatible with municipal strategy
  - Could evolve from the existing urban structure
- Figure 6 shows the relationship between markets and government action in shaping cities
Figure 6: Schematic representation of the interaction of markets and government action in shaping cities.