### Module 2: Spatial Analysis and Urban Land Planning

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

Alain Bertaud
Urbanist

#### **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 seems 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)

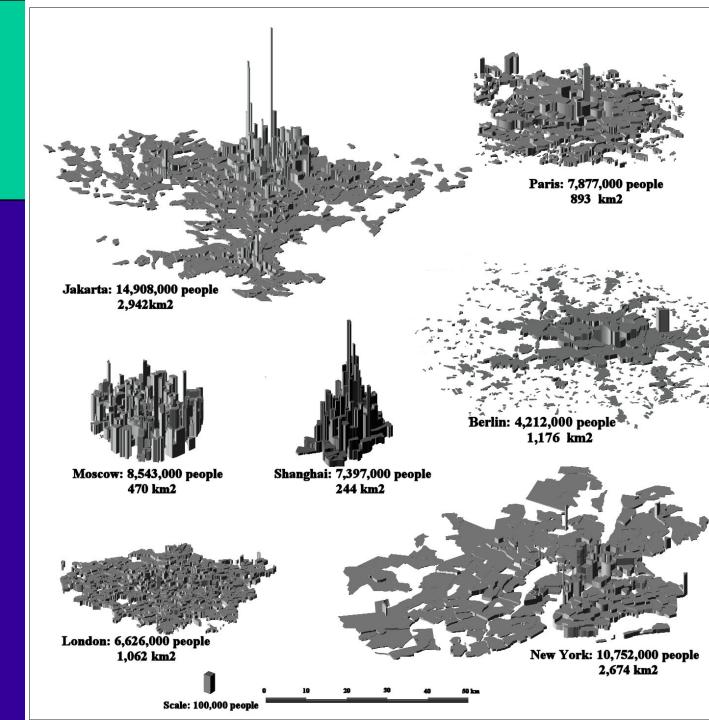
- Understanding the spatial organization of a city allow planners to
  - Predict the main directions of future development
  - Develop strategies which are compatible with the current spatial structure
  - Influence the evolution the current structure in a manner consistent with municipal objectives

### What are Urban Spatial Structures? (3)

- 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



#### **Section 2:**

# How do We Define and Measure Urban Spatial Structures?

## How do We Define and Measure Urban Spatial Structures?

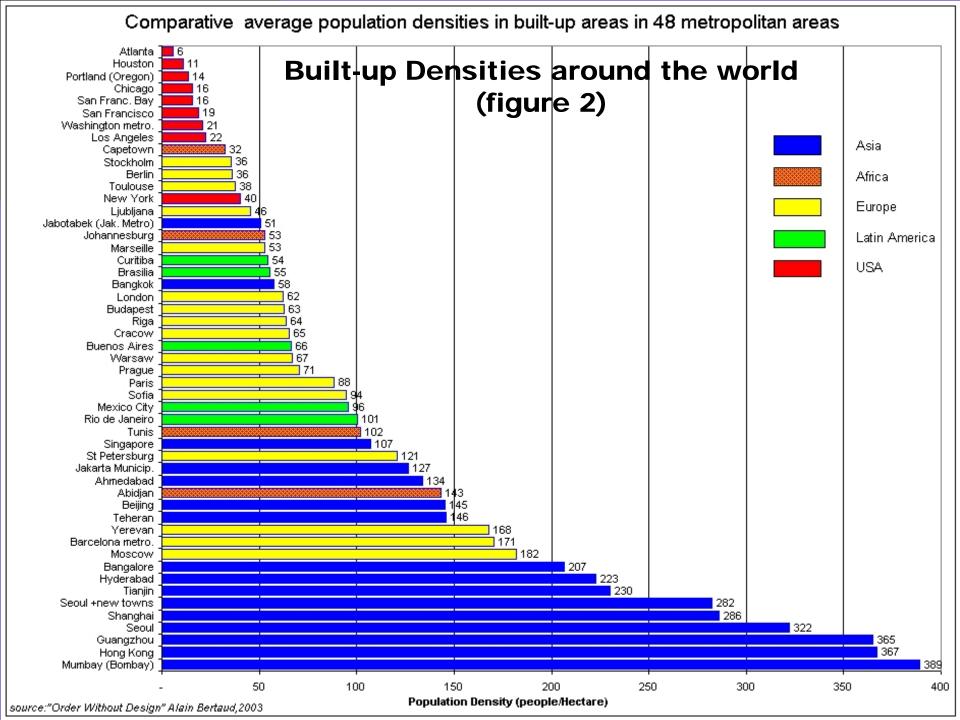
- We can define urban spatial structures using a number of indicators. We will only focus on 3 main indicators:
- Land consumption (density)
- Density profile
- Degree of monocentricity (share of trips with central destination)

## 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



#### **Urban Densities (2)**

- 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)**

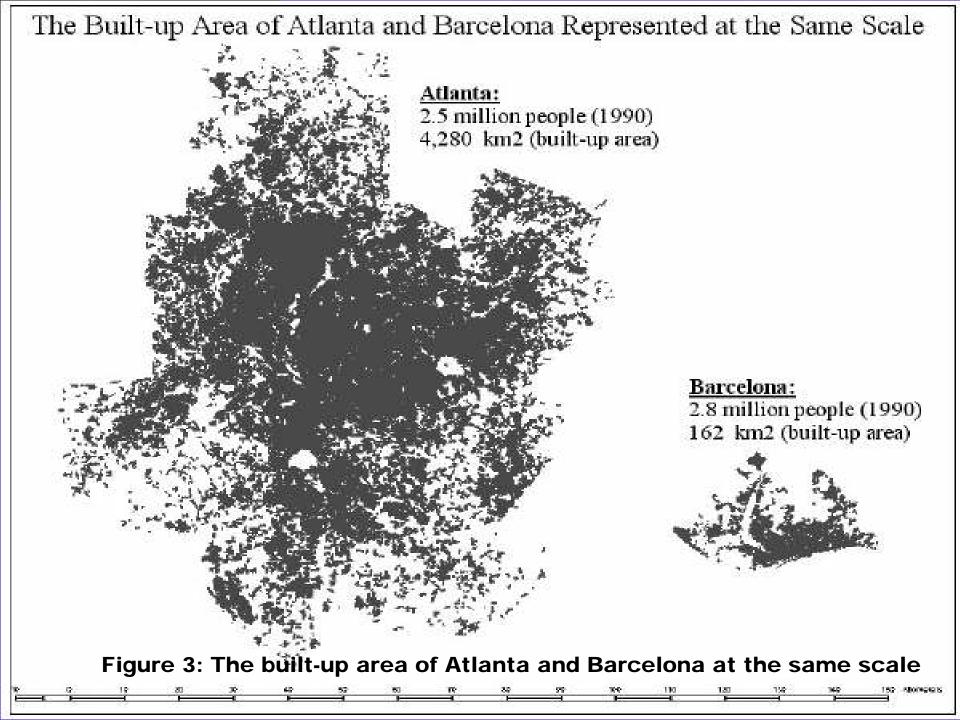
- Densities seems to be more related to regions than to income, implying that densities might have a strong cultural causality
- The high densities in Asian cities have not been "planned" but occurred because of cultural preferences expressed through land markets

### **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



## Urban Densities have Important Implications: Atlanta vs. Barcelona

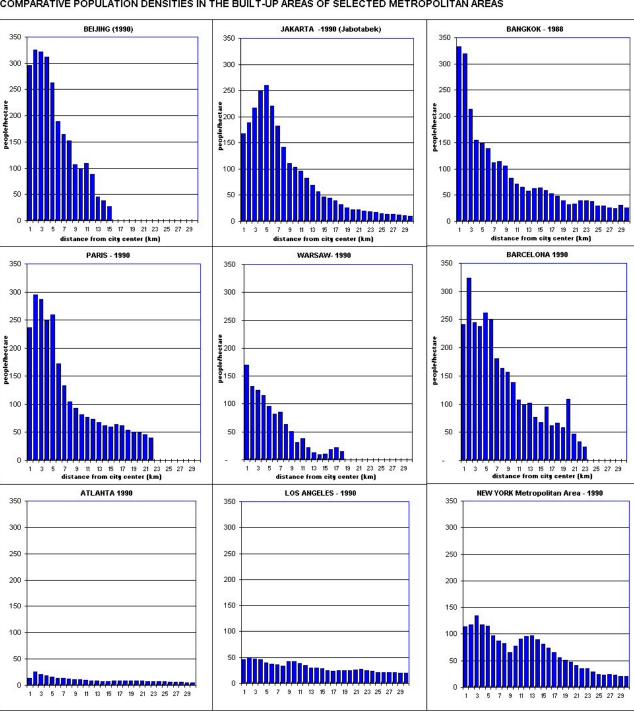
- Because of the difference of density, Atlanta's built-up area is 28 time larger than Barcelona's
- As a consequence, the metro of Barcelona is only 99 km long and its stations are within walking distance to 60% of the population
- By contrast, to provide the same service to the same number of people, 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



from "Order Without Design", Alain Bertaud, 2003

#### **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

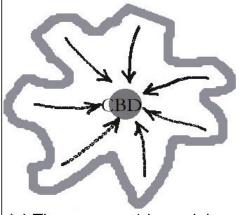
## Pattern of Daily Trips within the Built-up Area (1)

- 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

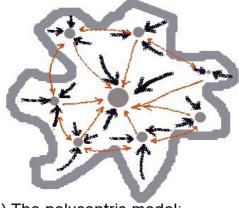
#### Figure 5:

Schematic representation of trip patterns within a metropolitan areas

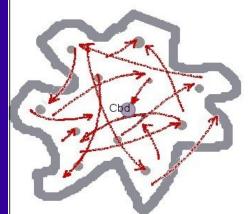
#### Schematic Representation of Trips Patterns Whithin a Metropolitan Area



(a) The monocentric model

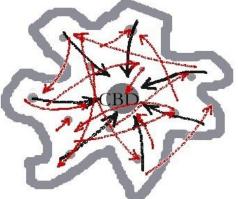


(b) The polycentric model:
The urban village version



(c) The polycentric model:
The random movement version





(d) The mono-polycentric model: Simulateous 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)

## Pattern of Daily Trips within the Built-up Area (3)

- 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

