WELL-BEING, URBAN PLANNING AND BIODIVERSITY IN BARCELONA

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Universitat Autònoma de Barcelona (UAB) and Institut de Ciència i Tecnologia Ambientals (ICTA)
Structure of the talk

- Problem and motivations of the problem
- Objectives and structural question
- Case study
- Methodology
- Concluding unanswered questions
Well-being and urban planning

• Cities: Past and present
• Agglomeration
• Shocks
• Urban services
• Natural ventilation
• Urban biodiversity
Determinants of the cities in the nineteenth to beginning twentieth centuries

Density, malnutrition, agglomeration, overworking, infected water, illiteracy → Causes

Mortality, ignorance, illness, unhappiness, uncultured, unsociability → Consequences

Shocks to the system:

Cities experienced a high incoming population during the industrial revolution

Population density increased in all of them

Mortality increased and life span decreased
Determinants of the cities in the beginning
Of the twenty-one century

Density, agglomeration, pollution, climate change, global warming  →  Causes
Scale diseconomies, intensive use of energy, personal discomfort  →  Consequences

Shocks to the system:

Cities are the central node of the twenty-one cultural paradigm, attracting population and economic activity

Consequences of economic downturns and global warming and climate change would increase population pressure and would change personal comfort

Social well-being would decrease
Objective and Structural Questions

. How urban planning and, in particular, the location of urban services, the conditions of natural ventilation and biodiversity levels affect well-being

Why
- To which extend provision of services improve well-being
- To which extend urban grid facilitates natural ventilation (insolation and winds)
- To which extend urban grid and natural ventilation would increase efficiency in energy saving
- To which extend biodiversity improve well-being
- We want to answer the question of ‘who gets welfare and where do they get it’
  -(Spatial justice)
- We want to get further elements to incorporate in future planning practices
  -(Policy making)

How
- Barcelona case is studied using location analysis and spatial analysis, and implemented in ArcGis

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Working Hypothesis

- Urbanism can be used as a well-being redistribution tool

- Planning services to population is a necessary condition to improve social well being

- The Cerdà Grid improves a more natural ventilation system which facilitates personal comfort, and energy efficiency saving than the North-South grid, such as New York, Chicago or Washington

- Increasing levels of biodiversity would rise personal comfort, and would mitigate climate change effects in cities
Quality of Life and Well-being

- Quality of life is identified as the satisfaction of desires associated with human needs and wants;
- Well-being as a general state of wellness.
Population and population density in cities, per Sq Km

Population Density
New York City, 1910

Persons per Acre
- 500.0 or more
- 350.0 to 499.9
- 250.0 to 349.9
- 150.0 to 249.9
- 100.0 to 149.9
- 50.0 to 99.9
- 25.0 to 49.9
- Less than 25.0

Population Density by Wards, 1904

Creator: Tenement Inspector
Source: Chicago Historical Society (ICHi-37341)

http://encyclopedia.chicagohistory.org/pages/10727.html
Average life expectancy between richer and poorer classes was 38.83 and 19.68 years of age, respectively (men, average between years 1837 and 1847; Cerdà, 1867)

Service location made by Cerdà
Provision of Services to Population

Planning equipments

<table>
<thead>
<tr>
<th>Type of services</th>
<th>Number</th>
<th>Number of blocks Occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parks</td>
<td>8</td>
<td>38</td>
</tr>
<tr>
<td>Markets</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Hospitals</td>
<td>3</td>
<td>Outside the city</td>
</tr>
<tr>
<td>Schools</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Government Institutions</td>
<td>12</td>
<td>25</td>
</tr>
</tbody>
</table>

Service provision in the Old Barcelona

- 10 midwifes and 69 surgeon doctors (Cerdà, 1867)

- 3 markets, 2 of them fisheries (Pescadería del Mercado del Borne, 425 m2, and Pescadería del Mercado de Isabel II, 900 m2), and 1 of them of general groceries (Mercado de la Plaza de Isabel II, 3,525 m2).
The optimization model (1)

- Location-Allocation

Minimize impedance. Minimize weighted impedance (P-Median). It chooses facilities such as the total sum of weighted impedances (demand allocated to a facility multiplied by the impedance to the facility) is minimized.

- ArcMap_10 Network Analyst
The optimization model (2)
General model:

Given
\[ \{a_i\}_{i=1}^{n}, \{d_{ij}\}_{i,j=1}^{n} \]

Choose
\[ \{y_j\}_{j=1}^{n}, \{x_{ij}\}_{i,j=1}^{n} \]

Where
\[ y_j \in \{0,1\}, \quad x_{ij} \in \{0,1\} \]

In order to minimize \( Z \) equal to
\[ \sum_{i=1}^{n} \sum_{j=1}^{n} a_i d_{ij} y_j x_{ij} \]

Subject to
\[ \sum_{j=1}^{n} y_j = p \]
\[ \sum_{j} y_j x_{ij} = 1, \forall i \]

Where,
- \( a_i \) = quantity of population in node \( i \),
- \( i \) = origin of population,
- \( j \) = possible service location,
- \( p \) = number of services,
- \( d_{ij} \) = the shortest distance between node \( i \) and node \( j \),
- \( x_{ij} = 1 \) if population of node \( i \) is assigned to \( j \), 0 otherwise,
- \( x_{jj} = 1 \) if a service is located in node \( j \), 0 otherwise.
School service areas
<table>
<thead>
<tr>
<th>Interval time in minutes</th>
<th>Population</th>
<th>%</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>41,297</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>5 - 10</td>
<td>75,259</td>
<td>49</td>
<td>76</td>
</tr>
<tr>
<td>10,1 - 15</td>
<td>27,263</td>
<td>18</td>
<td>94</td>
</tr>
<tr>
<td>&gt; 15</td>
<td>8,656</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>152,475</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Park service areas, 5, 10 and 20 minutes
Market service areas
Cerdà hospitals allocation of demand within 30 minutes distance
La ciudad es un espacio abierto donde mecanismos dinámicos de conectores y nódulos de recarga permeabilizan el sistema urbano y favorecen niveles de biodiversidad.

Modelos de naturación y naturalización

**Naturación:** estrategias de creación y adaptación de verde urbano con la finalidad de conseguir una fauna autóctona

**Naturalización:** proceso de entrada de biodiversidad faunística en sistema-ciudad en el paradigma sostenibilista.
Natural Ventilation and the Cerdà Grid

Streets of the New Barcelona

Area: 1,975 Ha

<table>
<thead>
<tr>
<th>Street type/ wide</th>
<th>Longitude (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 m</td>
<td>237,7</td>
</tr>
<tr>
<td>30 m</td>
<td>77,5</td>
</tr>
<tr>
<td>50 m</td>
<td>183</td>
</tr>
<tr>
<td>Streets with train</td>
<td>117,4</td>
</tr>
<tr>
<td>Streets Outside Enlargement</td>
<td>118,8</td>
</tr>
<tr>
<td>Perimeter</td>
<td>228,3</td>
</tr>
</tbody>
</table>

Streets of the Old Barcelona

Area: 193,97 Ha

<table>
<thead>
<tr>
<th>Street type/ wide</th>
<th>Number of streets</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 m</td>
<td>200</td>
</tr>
<tr>
<td>3-6 m</td>
<td>400</td>
</tr>
</tbody>
</table>
Bird's Eye View of Chicago, 1857

Creator: I. T. Palmatary and Christian Inger
Source: Chicago Historical Society (ICHi-05656)

http://encyclopedia.chicagohistory.org/pages/10603.html
Commissioner's Grid plan for Manhattan

Case Study
Data capturing: Cerdà’s Map spatial referentiation

Fig 1. Overlying the original Map and the current Barcelona’s grid
Insolation Summer Solstice (15-15,30h)
Insolation Winter Solstice (9,00-9,30h)
Insolation Winter Solstice (15,00-15,30h)
Kyushu University: A model of a baseball stadium in Japan, showing the airflow around the stadium. This was created with ArcView, ArcGIS 3D Analyst, and Airflow Analyst.

THE END

THANK YOU VERY MUCH

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