WELL-BEING AND URBAN PLANNING. PUBLIC SERVICES, NATURAL VENTILATION AND BIODIVERSITY IN BARCELONA

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Association of American Geographers Meeting
Ecologies of Well-being III 3429 Session

Thursday 11th April/2013, 1.40PM
Westin Hotel Venue Santa Monica C Level 3

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 questions
Insolation

45_December21_9h

90_December21_9h
Services
Green Distribution in Barcelona

- Blocs
- Permeable soil
- Continuous street tree canopy
Well-being and urban planning

- Cities: Past and present
- Agglomeration
- Shocks
- Urban services
- Natural ventilation
- Urban biodiversity

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.
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

Mortality increased and life span decreased
Population density increased

Determinants of the cities at 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
Working Hypothesis

- Urbanism can be used as a \textit{well-being redistribution tool}

- Planning \textit{services to population} is a necessary condition to improve social well being

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

- Increasing levels of \textit{biodiversity} would rise \textit{personal comfort}, and would mitigate \textit{climate change effects} in cities
Population Density New York City, 1910

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


http://encyclopedia.chicagohistory.org/pages/10727.html
Barcelona. Mortality in the first floor level
1846-1865

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)

Provision of Services to Population

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).

Planning equipment for the new Barcelona

<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 location made by Cerdà. The optimization model: 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

\( y_j \in \{0,1\} \)

\( x_{ij} \in \{0,1\} \)

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

![Map of Schoolservice areas](http://worldmap.harvard.edu/maps/Barcelona_Cerda_1860/CRD)

#### Table 4. Population within each school time interval

<table>
<thead>
<tr>
<th>Interval time in minutes</th>
<th>Population</th>
<th>%</th>
<th>Cummulative</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></td>
<td>100</td>
</tr>
</tbody>
</table>
### Population and parks

#### Population served by parks

<table>
<thead>
<tr>
<th>Interval in time minutes</th>
<th>Population</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>42,588</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>5 - 10</td>
<td>60,116</td>
<td>39</td>
<td>67</td>
</tr>
<tr>
<td>10,1 - 20</td>
<td>47,888</td>
<td>32</td>
<td>99</td>
</tr>
<tr>
<td>&gt;20</td>
<td>1,883</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>total</td>
<td>152,475</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Population within each market time-interval

<table>
<thead>
<tr>
<th>Interval time in minutes</th>
<th>Population</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–5</td>
<td>19,444</td>
<td>13.0</td>
<td>13.0</td>
</tr>
<tr>
<td>6–11</td>
<td>54,268</td>
<td>36.0</td>
<td>49.0</td>
</tr>
<tr>
<td>12–24</td>
<td>70,691</td>
<td>46.0</td>
<td>95.0</td>
</tr>
<tr>
<td>&gt;24</td>
<td>8,072</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>152,475</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

http://worldmap.harvard.edu/maps/Barcelona_Cerda_1860/CRD
Cerdà hospitals allocation of demand within 30 minutes distance

Table 1: Population within each hospital service area

<table>
<thead>
<tr>
<th>Interval time in minutes</th>
<th>Population</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–9</td>
<td>16,251</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>10–19</td>
<td>52,500</td>
<td>34.0</td>
<td>45.0</td>
</tr>
<tr>
<td>20–30</td>
<td>50,500</td>
<td>33.0</td>
<td>78.0</td>
</tr>
<tr>
<td>&gt;30</td>
<td>33,224</td>
<td>22.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>152,475</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
## 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>
- One of the Cerdà's objectives was to positioning the grid in order to get maximum sunshine and natural ventilation for housing

- More sustainable cities

- Old technique of house ventilation and natural air recycling and cooling inside the house

- He considered the streets as "aerial channels", which had the function for the city what lungs do for humans: “Por lo que toca a salubridad, siguiendo en esta parte a los highienistas, podemos considerar las calles como canales aereos (...) que vienen a ser para las ciudades como lo que para el cuerpo humano son los pulmones.” Cerdà, 185, p. 376 (1991)
Case Study
Insolation Summer Solstice (15-15,30h)
Insolation Winter Solstice (9,00-9,30h)
Insolation Winter Solstice (15,00-15,30h)
Airflow

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

MONTSERRAT PALLARES-BARBERA
Annex 5

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