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Using Big Data for Optimization &
Policy Evaluation
A Case Study of Beijing’s Bus Commuting

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Outline

• A little more about BIG DATA
• The essential question for professionals/scholars in the era of big data
• The proposed solution to the above question
• A case study
• Conclusions and discussions
A little more about BIG DATA

• What they would change?
• What they won’t change?
What they would change?

• Mobile network
• Credit card system
• Social media
• Digital exhaust
• ......
What they would change?(2)

Most importantly (or essentially):

• How we are connected, communicate and interact

• How we observe and intervene with social processes and interactions, esp. peer learning and how we learn from exemplars (or failures)
What they would change? (3)

“The unimaginable, fundamental changes that have occurred in our lifetimes have not been the result of rational state planning, manipulation by political elites, or activist organizations. A society-wide process of **tacit learning from peers** and **exemplars** built new paradigms and practices, ultimately normalizing new realities.”

----Kim, 2011
What they won’t change?

• The mission of each profession (esp. long-established ones), e.g., Urban Planning will still be deeply concerned about the future, space, quality of life, efficiency and equality)

• The processes of how wisdom is produced and utilized

• The nature of cities, esp., the physical resource constraints faced by all the cities and the factors constitute/govern cities

• The hard work before dreams come true

• ......
What they won’t change?

- Data
  - Raw: Red, 192.234.235.245.678, v2.0
- Information
  - Meaning: South facing traffic light on corner of Pitt and George Streets has turned red
- Knowledge
  - Context: The traffic light I am driving towards has turned red
- Wisdom
  - Applied: I better stop the car!
“All cities can be understood in terms of a theoretical framework that combines two main processes, namely, the dynamics of agglomeration/polarization, and the unfolding of an associated nexus of locations, land uses and human interactions...Agglomeration can be generally understood as sharing, matching and learning...The urban land nexus, meaning an interacting set of land uses expressing the way in which the social and economic activities of the city condense out into a differentiated, polarized, locational mosaic.”

----Scott and Storper, 2014
What they won’t change?(4)

“Five such variables would appear to be of special significance...

1. Overall levels of economic development...
2. The rules that govern resources allocation...
3. Prevailing structures of social stratification
4. Cultural norms and traditions
5. The overarching conditions of political authority and power…”

----Scott and Storper, 2014
The essential question?
The essential question?

• Reconsider the mission of one’s field, if necessary
• Understand the changed and the unchanged in one’s field
• Identify ways to deconstruct or frame the problem at hand based on the above understandings
• Fulfill the mission rather than follow the crowd!
The proposed solution

• Don’t try to define or explain the problem if you cannot even propose a solution or have some clues about the solution
• Only define or explain the question when you at least know what, who and where the solution could be; at best, you should have some feasible solution
• Never forget about the mission of your own field----Don’t attempt to solve other fields’ problems before solving the problem in your own field
The proposed solution(2)

The three layers of mission of a man (The Godfather):
• Be a responsible and capable man
• Be a responsible and capable man for the family
• Be a responsible and capable man for the country
• 正心、修身、齐家、治国、平天下
The proposed solution (3)

“The information needed to understand the problem depends upon one’s ideas for solving it......to find the problem is thus the same thing as finding the solution; the problem can’t be defined until the solution has been found.”

----Rittel and Webber, 1973
The proposed solution (4)

• More about solutions, less about problems!
多谈些主意，少谈些问题！
• Define a problem while proposing some solution
摸着石头过河
A case study of Beijing bus commuting

• Data: Smartcard data
• Info: Derived origins and destinations of bus commuters
• Knowledge:
  --Where and when bus commuters travel to and from
  --Who (Need extra survey data)
  --Why (Need extra local knowledge, field trips, interviews, etc.)
• Wisdom:
  --Possible land use mix that would reduce commute distance
  --Who/where would be the losers/winners when optimizing bus commuting
  --Effectiveness of different policy scenarios (commuting economy)
Where and when bus commuters travel to and from
& optimal pattern
(Space, efficiency & limited resources)
Where there could be jobs-housing separation & excess commuting
(Space/land use, quality of life, equity (?) and efficiency)
J-h separation “hotspots”
### Hotspots and land use

<table>
<thead>
<tr>
<th>Prototype</th>
<th>Characteristics</th>
<th>Landmarks and Directions</th>
<th>Spatial Index in Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University campuses, hotels and old Danwei compounds left with mostly apartment buildings</td>
<td>Minzu and Jiaotong Universities and areas in between; Beijing Technology and Business University and Capital Normal University (east campus) and areas adjacent to them; Beijing University of Aeronautics and Astronautics and Beijing University of Science and Technology and adjacent areas</td>
<td>A (Areas around and areas to its northeast)</td>
</tr>
<tr>
<td>2</td>
<td>Parks with luxury hotels, high-end apartments, specialized research institutes, hospitals and some mixed-use residential areas</td>
<td>Areas north to Yu Yuan Tan Park; Area adjacent to Tian Tan Park in the east</td>
<td>A (South to A, the darkest area); The U-shaped area south to the star</td>
</tr>
<tr>
<td>3</td>
<td>Traditional Hu’tong with old, cheap, small, shared and underserviced rental housing units</td>
<td>Areas in between Qian Men Da Jie and Zhu Shi Kou Da Jie</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>Residential areas with mixed-age housing units adjacent to freeway interchanges or arterials, railways within the fifth ring road</td>
<td>Areas near Yong Ding Men and Nan Sha Wo Bridges</td>
<td>C</td>
</tr>
<tr>
<td>5</td>
<td>Low density, developing areas with relatively cheap housing units in the suburb</td>
<td>Areas adjacent to the sixth ring road and Jingshi Freeway interchange; Areas adjacent to Yan Chun Railway Station</td>
<td>D</td>
</tr>
</tbody>
</table>
Losers and winners in optimization (Space, equality and efficiency)
<table>
<thead>
<tr>
<th>TAZs</th>
<th>Land use patterns</th>
<th>Housing characteristics</th>
<th>Amenities</th>
</tr>
</thead>
<tbody>
<tr>
<td>289</td>
<td>Parks and lakes, established residential areas</td>
<td>Middle-rise apartments developed in the past 30 years or so</td>
<td>Parks and lakes, restaurants and retail shops in and around the residential areas</td>
</tr>
<tr>
<td>301</td>
<td>Sewage plants, brown field, residential areas, warehouses and factories</td>
<td>Scattering middle-rise and high-rise apartments developed in the past 20 years or so</td>
<td>Few public facilities</td>
</tr>
<tr>
<td>797</td>
<td>University campus, low-cost markets and restaurants, high-end gated communities, parks and lakes</td>
<td>Newly developed single-family homes, long-existing farmers’ homes</td>
<td>Parks and lakes</td>
</tr>
<tr>
<td>1006</td>
<td>Villages, mountains, agriculture</td>
<td>Long-existing farmers’ homes</td>
<td>Mountains, trees, few public facilities</td>
</tr>
</tbody>
</table>
Policy scenarios and commute patterns (Future, limited resources, efficiency and space)
Policy Scenario 1 - $T_{ran1}$

Policy Scenario 2 - $T_{ran2}$

Policy Scenario 3 - $T_{ran3}$

$T_{ran1}, \ldots, T_{ran3}$, which are of less policy relevance
Commuting economy under different policy scenarios
Conclusions and discussions

• More about solutions, less about problem
多谈些主意，少谈些问题！
• Customized understandings of the changed and unchanged in one’s field in the era of big data
固本守源，因势利导
• Conduct one’s research in light of the field’s mission (probably one’s strength and interest as well), do not simply follow the crowd
正心、修身、齐家、治国、平天下，顺序不可颠倒
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Dilemmas in a General Theory of Planning*

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ALLEN J. SCOTT AND MICHAEL STORPER