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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."
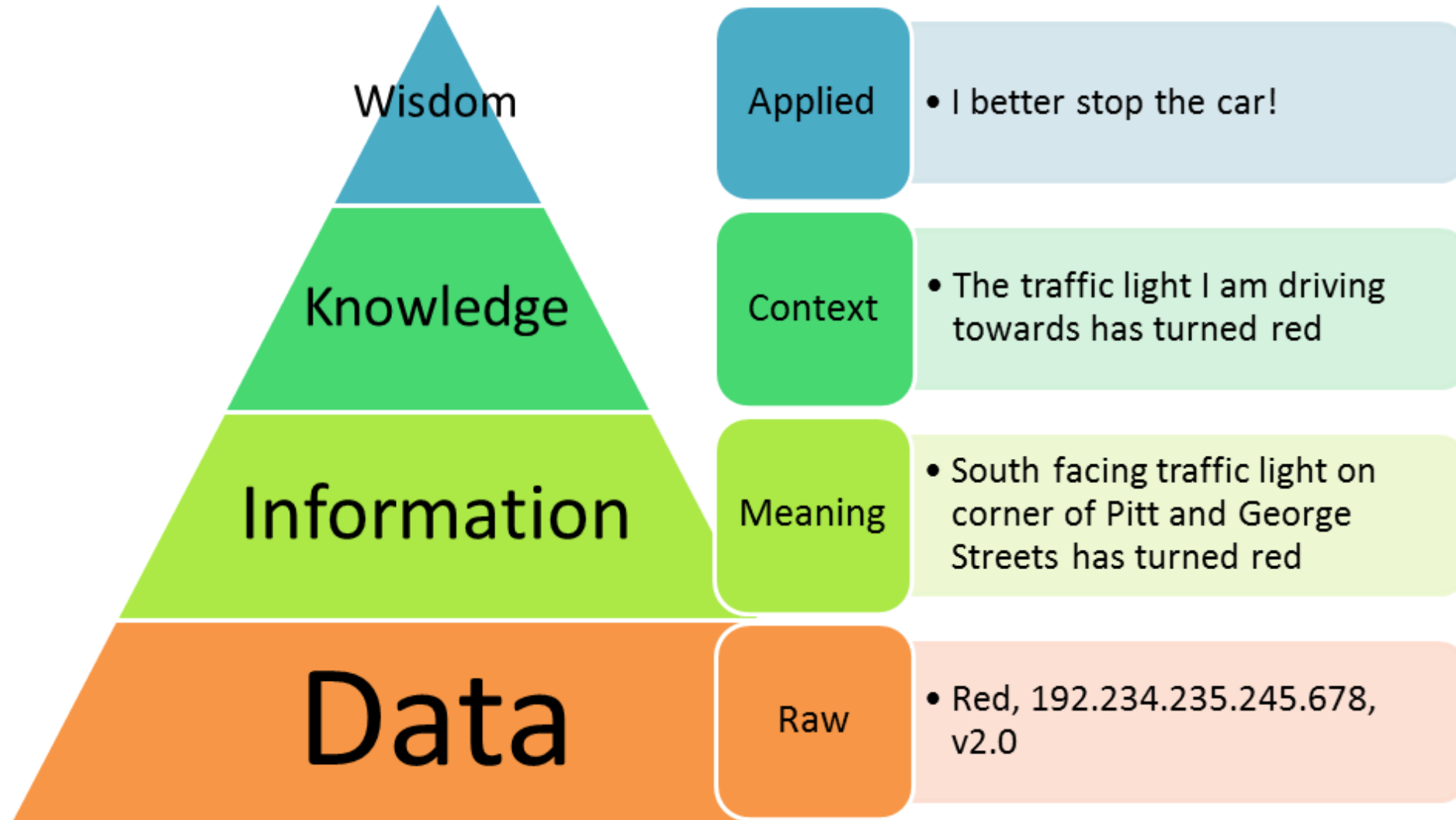
----Kim, 2011

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?(2)

Wisdom	Applied	• I better stop the car!
Knowledge	Context	• The traffic light I am driving towards has turned red
Information	Meaning	• South facing traffic light on corner of Pitt and George Streets has turned red
Data	Raw	• Red, 192.234.235.245.678, v2.0

What they won't change?(3)

"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

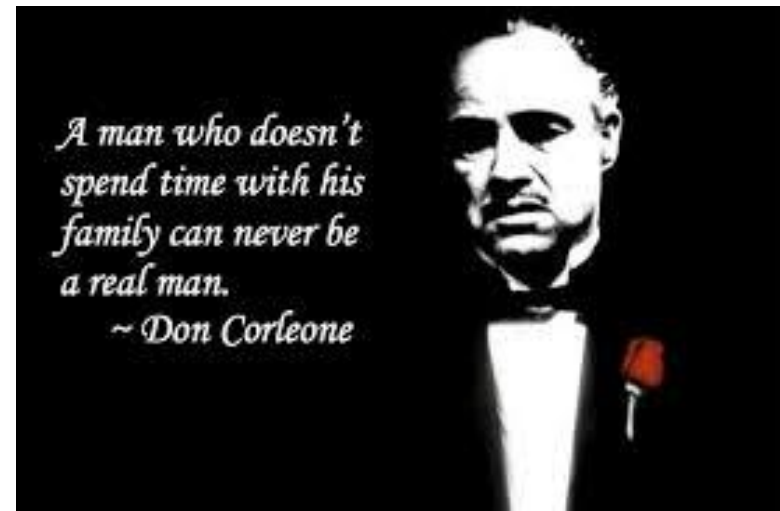- Fulfill the mission rather than follow the crowd!

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

A man who doesn't spend time with his family can never be a real man.
~ Don Corleone

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)

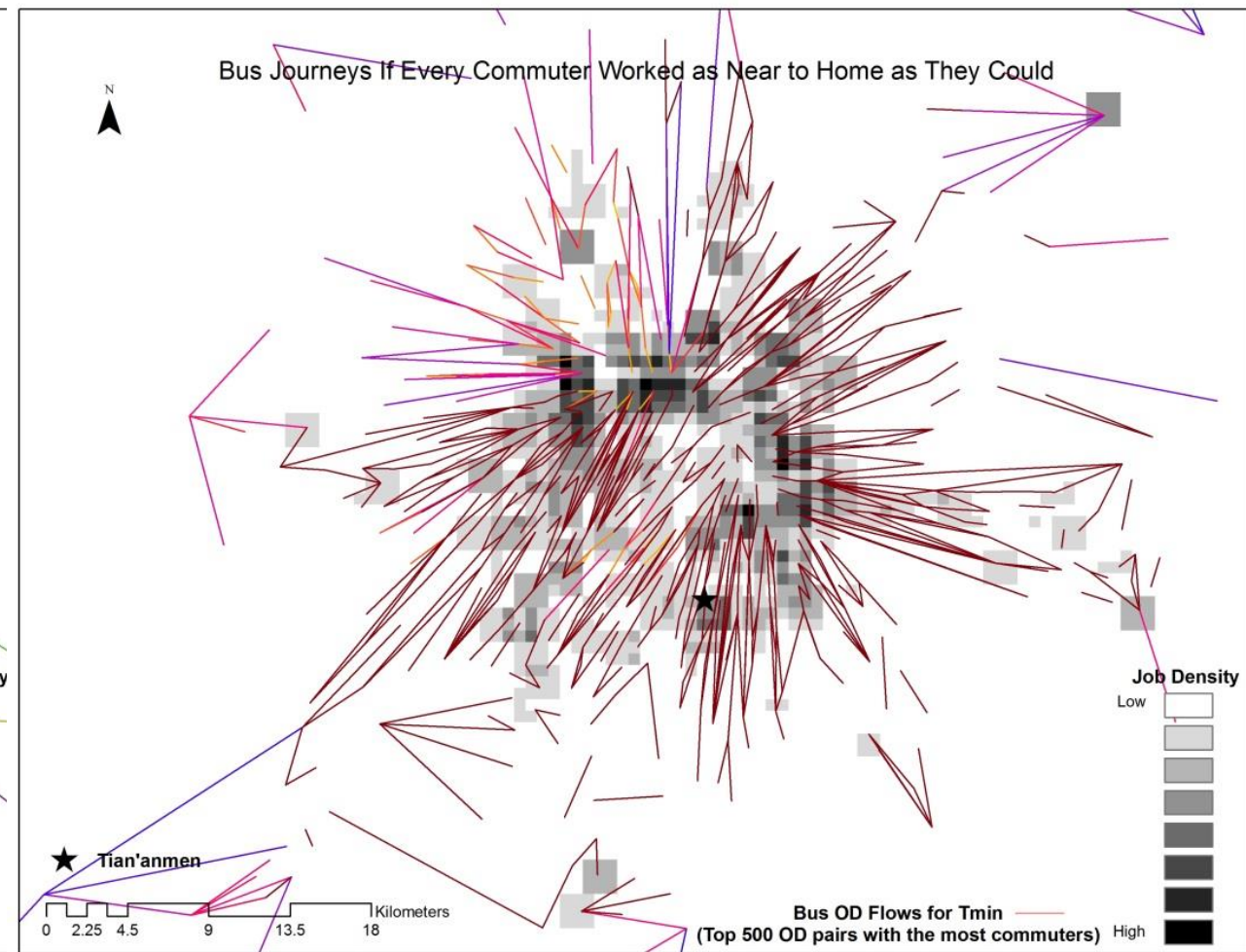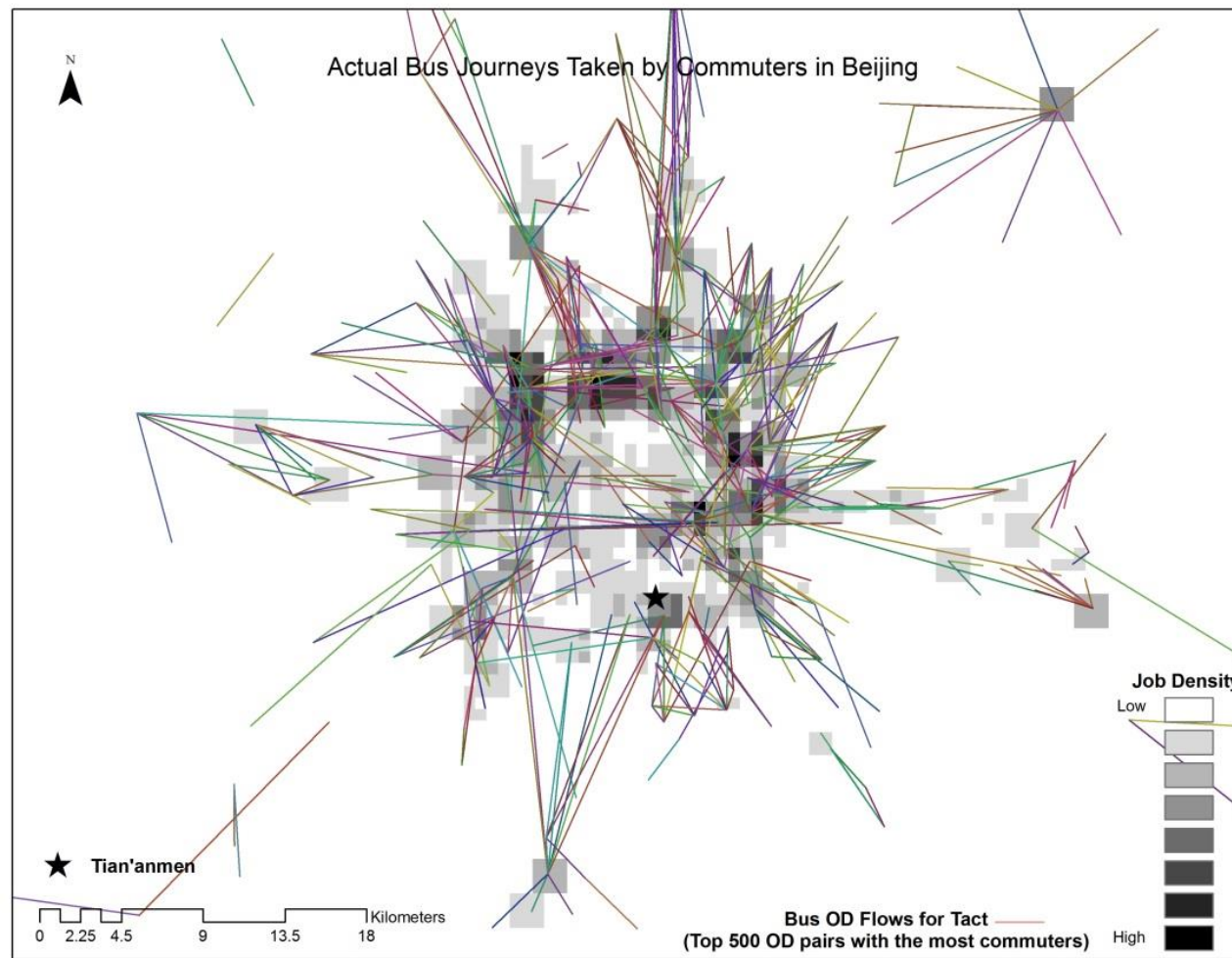- More about solutions, less about problems!

多谈些主意，少谈些问题！

- Define a problem while proposing some solution
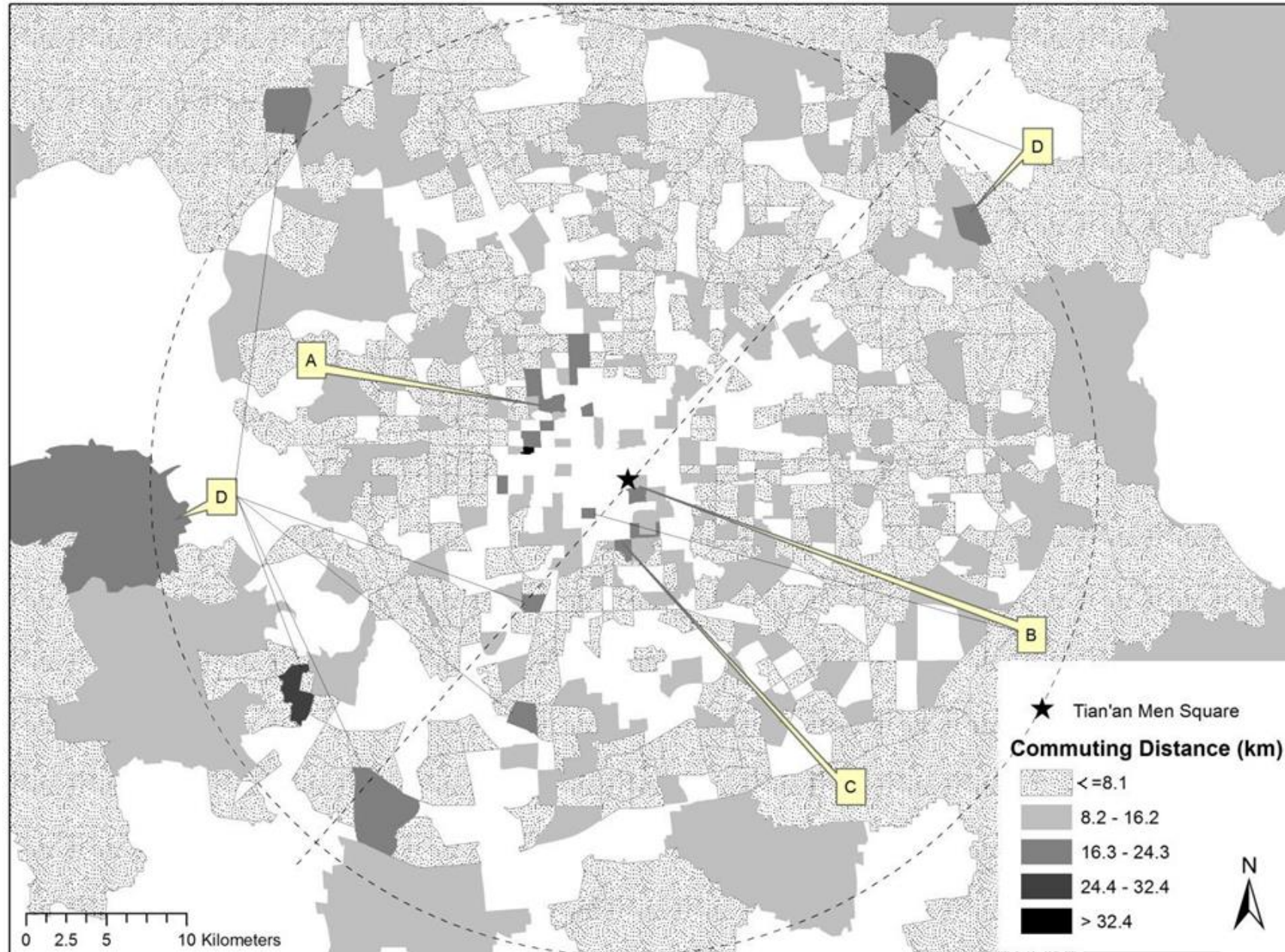
摸着石头过河

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)

Actual Bus Journeys Taken by Commuters in Beijing

Bus Journeys If Every Commuter Worked as Near to Home as They Could

Job Density

Low

High

★ Tian'anmen

Kilometers

0 2.25 4.5   9   13.5   18

Bus OD Flows for Tact
(Top 500 OD pairs with the most commuters)

Bus OD Flows for Tmin
(Top 500 OD pairs with the most commuters)

Where there could be jobs-housing separation & excess commuting
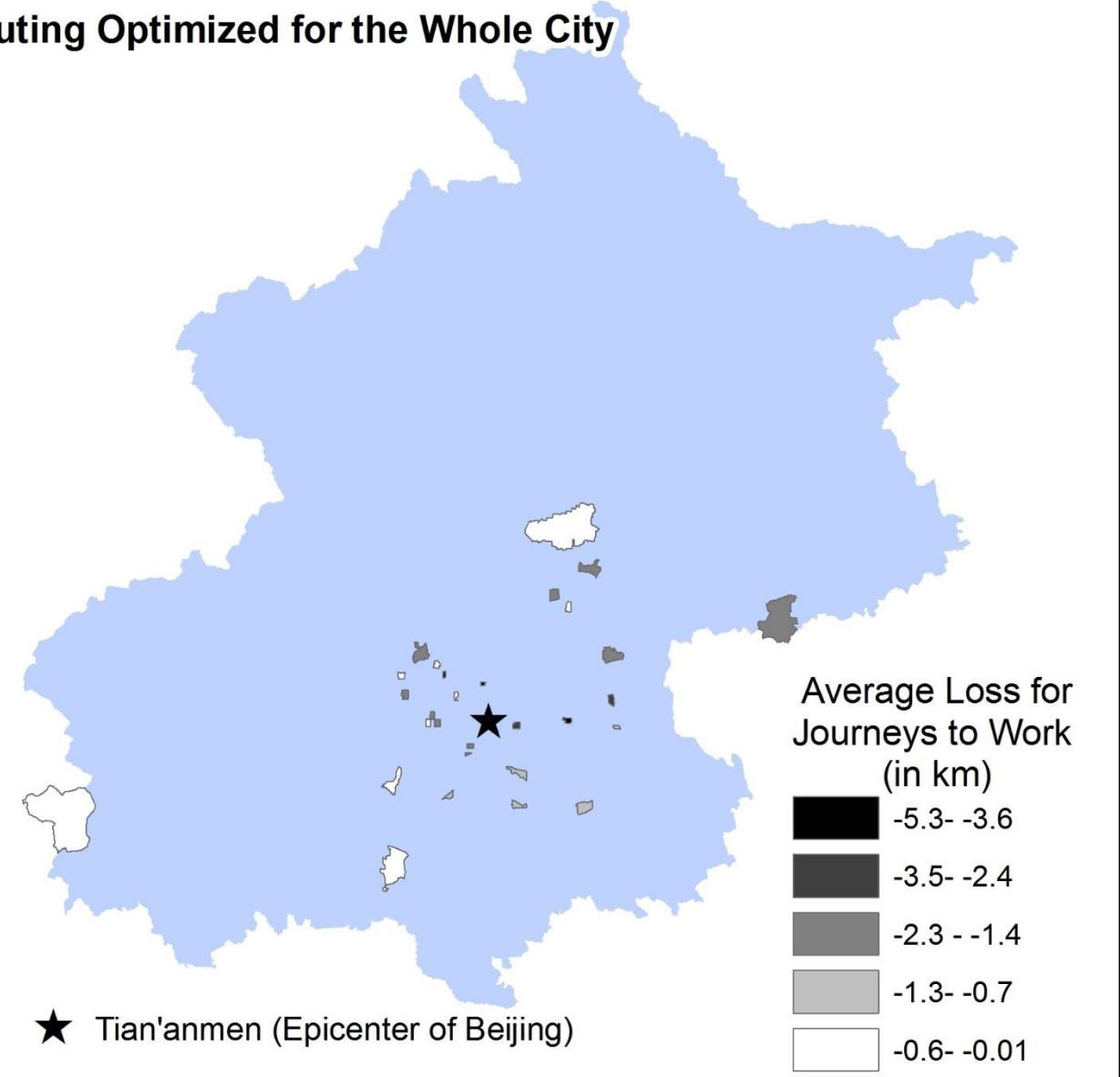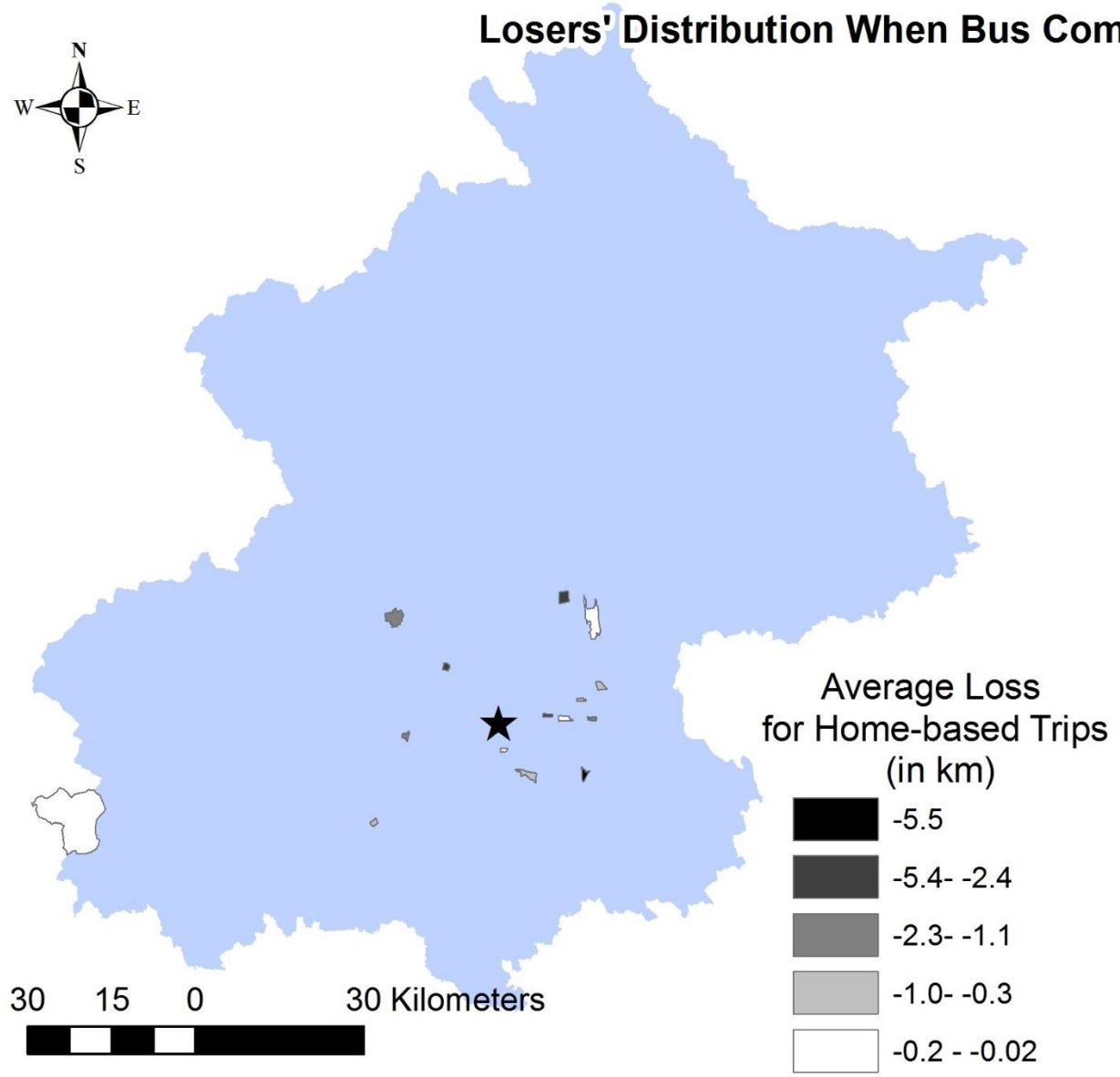(Space/land use, quality of life, equity (?) and efficiency)

J-h separation "hotspots"

Hotspots and land use

Prototype	Characteristics	Landmarks and Directions	Spatial Index in Figure
1	University campuses, hotels and old Danwei compounds left with mostly apartment buildings	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	A (Areas around and areas to its northeast)
2	Parks with luxury hotels, high-end apartments, specialized research institutes, hospitals and some mixed-use residential areas	Areas north to Yu Yuan Tan Park; Area adjacent to Tian Tan Park in the east	A (South to A, the darkest area); The U-shaped area south to the star
3	Traditional Hu'tong with old, cheap, small, shared and underserviced rental housing units	Areas in between Qian Men Da Jie and Zhu Shi Kou Da Jie	B
4	Residential areas with mixed-age housing units adjacent to freeway interchanges or arterials, railways within the fifth ring road	Areas near Yong Ding Men and Nan Sha Wo Bridges	C
5	Low density, developing areas with relatively cheap housing units in the suburb	Areas adjacent to the sixth ring road and Jingshi Freeway interchange; Areas adjacent to Yan Chun Railway Station	D

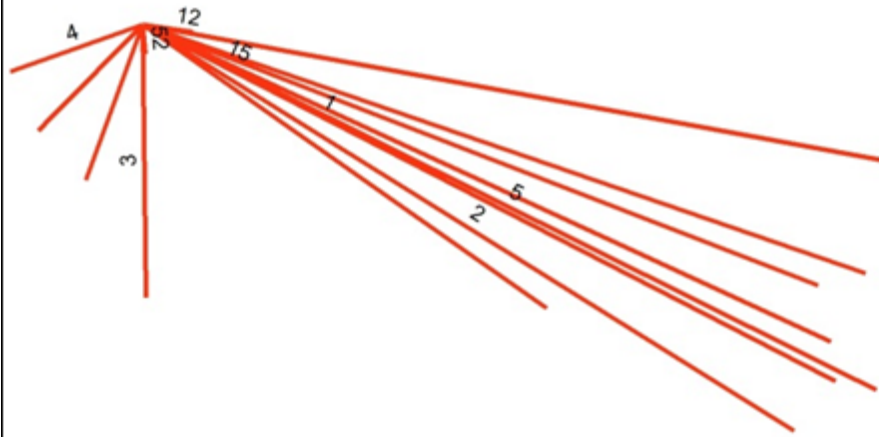# Losers and winners in optimization (Space, equality and efficiency)

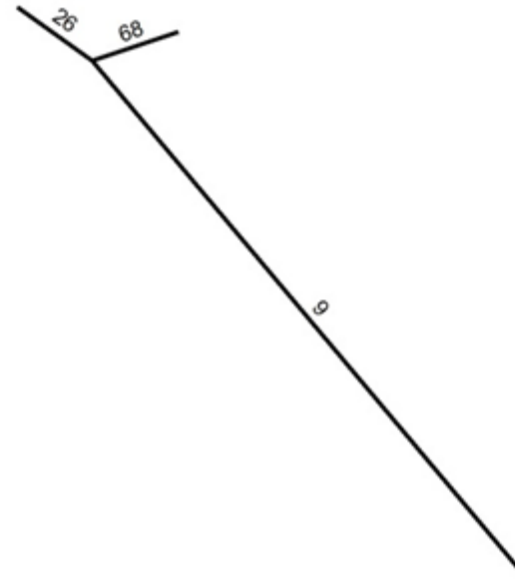**Losers' Distribution When Bus Commuting Optimized for the Whole City**

Average Loss
for Home-based Trips
(in km)

- -5.5
- -5.4- -2.4
- -2.3- -1.1
- -1.0- -0.3
- -0.2- -0.02

Average Loss for
Journeys to Work
(in km)

- -5.3- -3.6
- -3.5- -2.4
- -2.3- -1.4
- -1.3- -0.7
- -0.6- -0.01

★ Tian'anmen (Epicenter of Beijing)

30 15 0   30 Kilometers

Hotspots for losers: Housing and land use characteristics

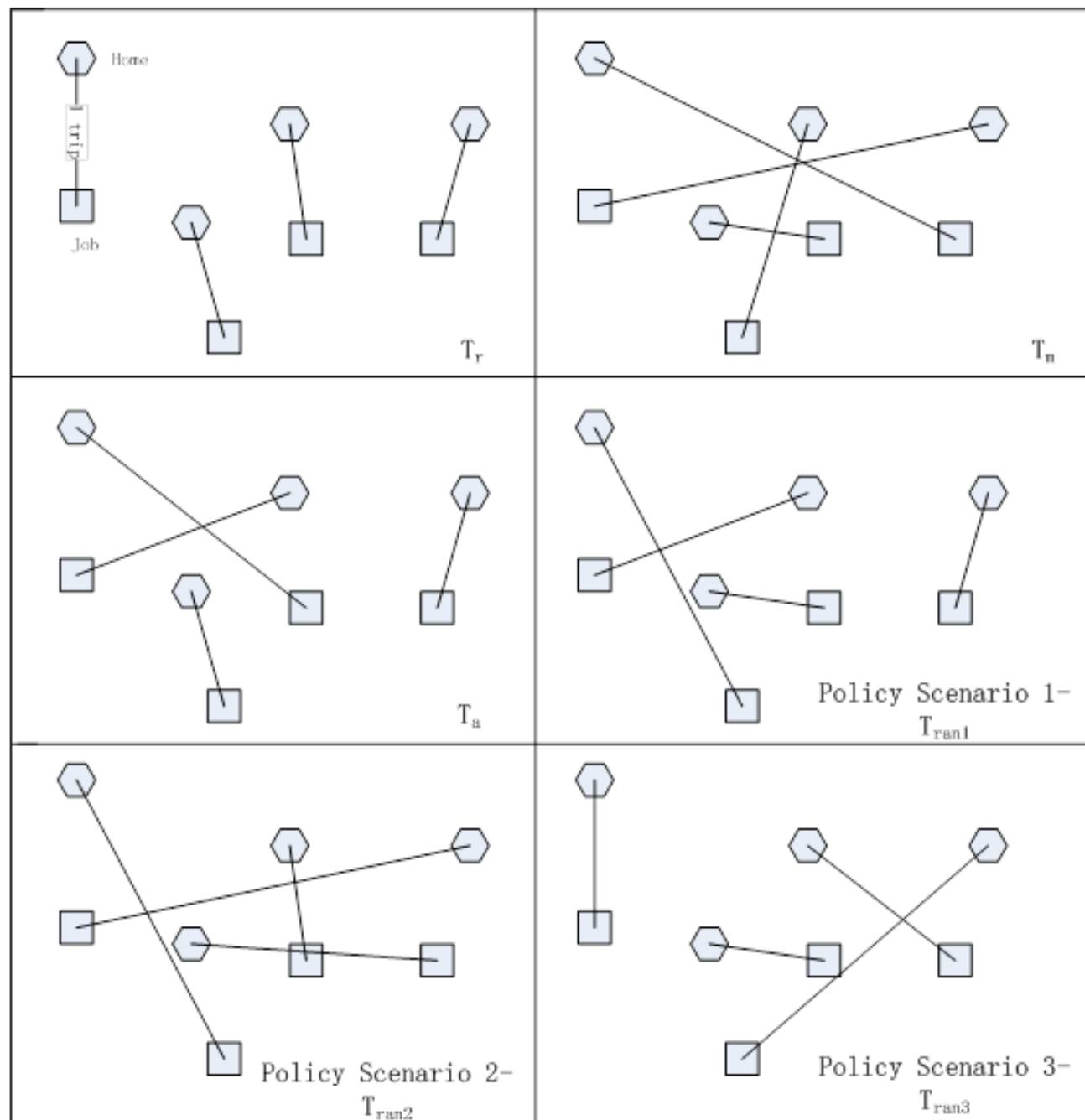| TAZs	Land use patterns	Housing characteristics	Amenities
289	Parks and lakes, established residential areas	Middle-rise apartments developed in the past 30 years or so	Parks and lakes, restaurants and retail shops in and around the residential areas
301	Sewage plants, brown field, residential areas, warehouses and factories	Scattering middle-rise and high-rise apartments developed in the past 20 years or so	Few public facilities
797	University campus, low-cost markets and restaurants, high-end gated communities, parks and lakes	Newly developed single-family homes, long-existing farmers' homes	Parks and lakes
1006	Villages, mountains, agriculture	Long-existing farmers' homes	Mountains, trees, few public facilities

Before Optimization
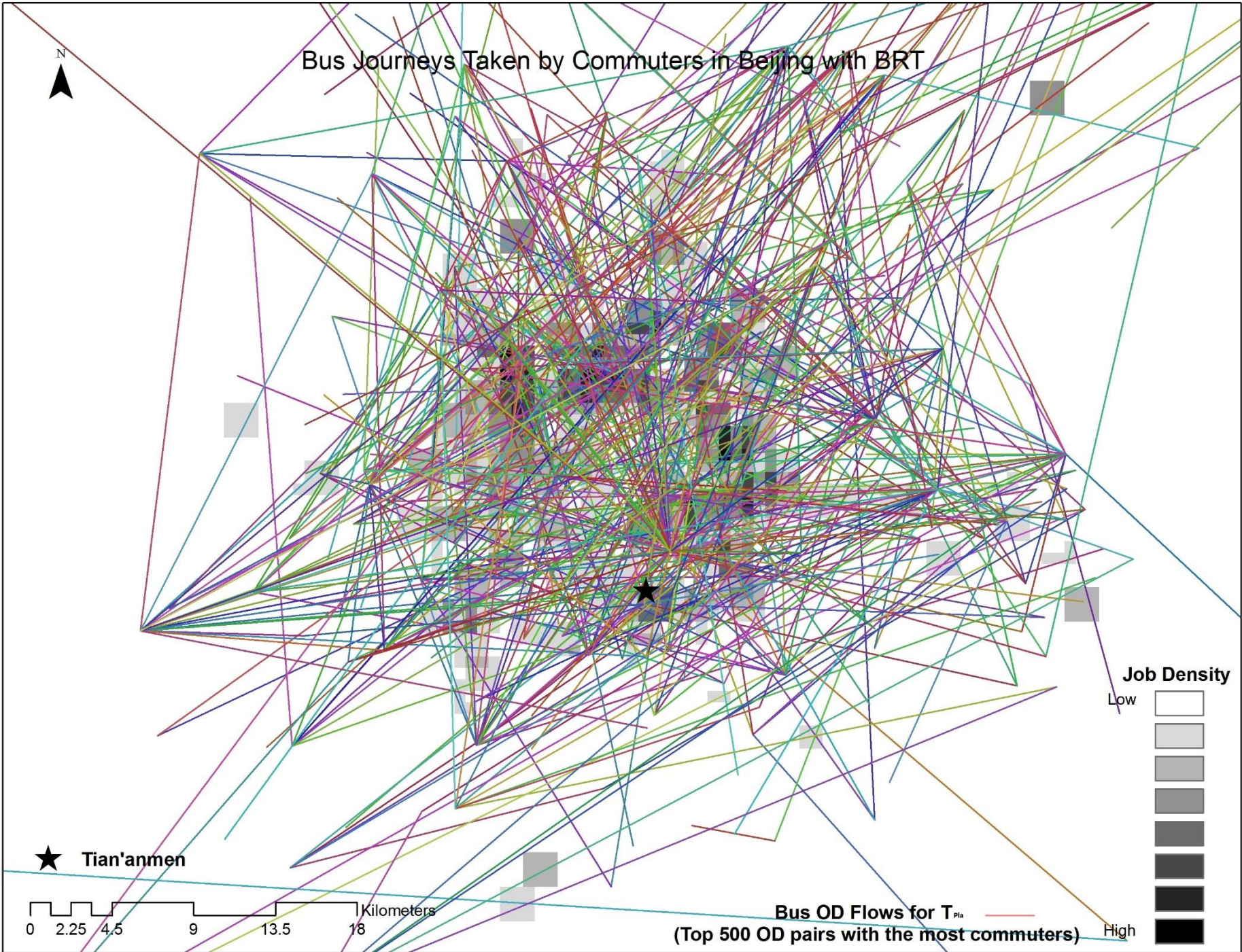
4
12
52
15
3
1
5
2

After Optimization

26
68
9

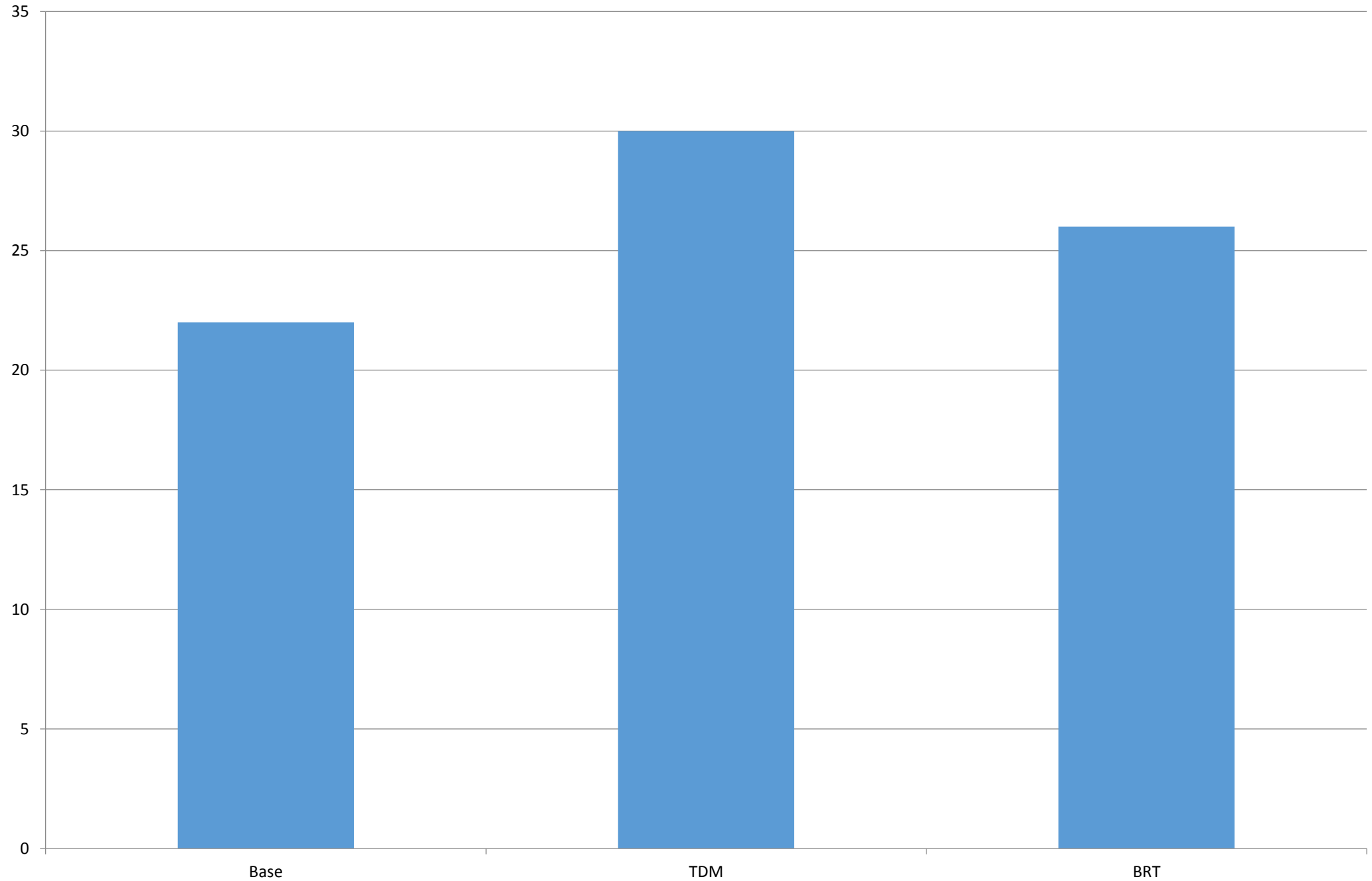Policy scenarios and commute patterns (Future, limited resources, efficiency and space)

$T_{ran4}\cdots,T_{ran13},$ which are of less policy relevance

Bus Journeys Taken by Commuters in Beijing with BRT

★ Tian'anmen

Kilometers
0   2.25 4.5   9   13.5   18

Bus OD Flows for T_Pla
(Top 500 OD pairs with the most commuters)

Job Density

Low

High

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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Journal of the American Planning Association

Unimaginable Change

Annette M. Kim [a]

[a] Massachusetts Institute of Technology's, Department of Urban Studies and Planning
Published online: 18 Oct 2011.

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Dilemmas in a General Theory of Planning*

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ALLEN J. SCOTT AND MICHAEL STORPER