

# The impacts of emerging big data and social media on urban planning and management in Chinese cities

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# Background & Introduction

“Urbanization in China, along with technology developments in the U.S., are the two most important issues that will shape the world’s development during the 21st century.”

--Joseph E. Stiglitz  
(Nobel Memorial laureate in Economics )

## Urbanization in China: Challenges and Opportunities

Images removed due to copyright restrictions. Graphics and photos of urban population growth in China.  
Source: unknown.

# Background & Introduction

- “Buzzwords” trend: World v.s. China

Images removed due to copyright restrictions. Line graphs and bar graphs of the buzzwords "cloud computing" and "internet of things" in China and the rest of the world.  
Sources: Google Trends <http://www.google.com/trends/> Baidu Index <http://index.baidu.com/>.

Images removed due to copyright restrictions.  
Buzzword trends for all years available shown over maps of China.  
Source: <http://index.baidu.com/>.

Images removed due to copyright restrictions.  
Buzzword trends for all years available shown over maps of China.  
Source: <http://index.baidu.com/>.

Source: <http://index.baidu.com/> Based on keyword in news, webpages and searches.

# A Brief History of Internet of Things (IoT)\*

Image removed due to copyright restrictions. Timeline of the history of "The Internet of Things"  
Source: <http://postscapes.com/internet-of-things-history>.

Source: <http://postscapes.com/internet-of-things-history>

# Concept: Internet of Things (IoT) (物联网)

“Many or most of the everyday objects and people in our lives can be uniquely identified and linked together into a network, using a variety of 'tagging' technologies, thereby sharing data and interacting to make our lives more convenient and efficient.”\*

Images removed due to copyright restrictions. Infographics depicting "The internet of things."  
Sources: <http://www.intel.com/content/www/us/en/intelligent-systems/iot/internet-of-things-infographic.html?wapkw=internet+of+things>.  
<http://www.itu.int/en/Pages/default.aspx>.

Source: [www.itu.int/internetofthings](http://www.itu.int/internetofthings)

Source: <https://scoop.intel.com/celebrating-international-internet-of-things-day/>

# General Concept: IoT and Smart World

Image removed due to copyright restrictions. Infographic of Top 50 sensor applications.  
Source: [http://www.libelium.com/top\\_50\\_iot\\_sensor\\_applications\\_ranking/#show\\_infographic](http://www.libelium.com/top_50_iot_sensor_applications_ranking/#show_infographic).

# National Support on ICT in China

- **12<sup>th</sup> Five Year Plan (2011-2015) (09/2011)**

Information and Communication Technology (ICT) industry: one of the seven emerging strategic industries (State Council, 07/2012)

- Internet of Things, Cloud Computing, Intelligent Transportation System, Wireless City, Information service platforms covering (social security, education, health service, employment etc.), Smart Grid, ...
- Digitalization and informatization of urban services

Image removed due to copyright restrictions. Screenshots from the Chinese Central Governments Official Website. Source: [www.GOV.cn](http://www.GOV.cn).

- **Several Opinions on Promoting Information Consumption and Boosting Domestic Demand** (State Council, 08/2013)

- Facilitate the sharing, using and developing of public data
- Improve information services related to people's lives
- Accelerate building smart cities

# National Support on IoT and iCities in China

## Policy Support on IoT

- The IOT space falls within regulatory ambit of **MIIT and MOF**.
- **12<sup>th</sup> Five-Year Plan on the IOT** (MIIT, 09/2011)
  - ❑ Previously discussed policy summaries
  - ❑ Establishment of the 23-sqkm Wuxi National IoT Innovation and Demonstration Zone
- **IoT Special Fund Interim Measures** (MOF, 04/2011)
- **Guidance Opinion on the Orderly and Healthy Development of the IOT** (State Council, 02/2013)
- **Notice on Properly Implementing the 2013 IOT Special Fund Project Application** (MIIT & MOF, 04/2013)
  - ❑ **In 09/2013, among the 122 application of projects for the Special Fund, 31 are related to transportation, and air/water/ environmental pollution, etc.**

## Smart City/ iCity (Intelligent City )

- **Collaborations between**
  - ❑ **Ministry of Industry and Information Technology (MIIT)**
  - ❑ **Ministry of Finance (MOF)**
  - ❑ **Ministry of Housing and Urban-Rural Development (MOHURD)**
  - ❑ **Ministry of Science and Technology (MOST)**
  - ❑ **National Development and Reform Commission (NDRC)**
  - ❑ **Ministry of Land and Resources (MLR)**
  - ❑ **Chinese Academy of Sciences**
  - ❑ **Chinese Academy of Engineering**

Image removed due to copyright restrictions. iCity infrastructure.  
Source: unknown.

# Features of "Big" Data – Where do they come from?

- **(Government oriented ) Urban sensing and monitoring**
  - Environment monitoring system (air quality, water quality, ...)
  - Intelligent transportation system (smart card transaction, vehicle AVL, parking availability, ...)
  - Infrastructure usage (electronic payment, loop detector, ...)
  - Remote sensing (Lidar)
  - ...
- **Enterprise collected information**
  - Credit card transaction data
  - Cell phone data
  - Point of interest (POI)
  - Housing rent and transaction information
  - ...
- **User contributed (Web or Mobile -based applications)**
  - Social Media (microblog, rating and review, ...)
  - Crowd-sourcing (building directory, document share, openstreetmap, etc)
  - Crowd sensing (traffic, air quality, temperature, etc)

# Emerging "Big" Data - Similarity and Dissimilarity

- **Similarity**

- Size of data is big
- Disaggregated
- Temporally registered
- longitudinal as opposed to cross-sectional
- Anonymous
- ...

- **Dissimilarity**

- Quality of data
- Sample size and representation
- Spatially registered
- Information (attributes)
- ...

Image removed due to copyright restrictions. Electronics & data tree diagram.  
Source: unknown.

# Social Media in China

Image removed due to copyright restrictions. Infographic of Social Media landscape @China 2012.  
Source: <http://www.seeisee.com/sam/2013/04/02/p3682>.

# Social Media in China

Users of social media grow rapidly in China, especially SNS, Weibo (microblog), IM, Group buy.

Image removed due to copyright restrictions. Bar graphs showing social media use in China.  
Source: <http://www.nielsen.com/us/en.html>.

# IMPACTS ON PLANNING

# Case 1. Air Quality Information

Based on Liu et al (2012) Red and Green: Public Perception and Air Quality Information in Urban China.

Image removed due to copyright restrictions. Photograph of smog in an urban area.  
Source: unknown.  
Based on Liu et al. "Red and Green: Public Perception and Air Quality Information in Urban China." *Environment: Science and Policy for Sustainable Development* 54, no. 3 (2012): 44-9.

## Air Quality Information

- Central government evaluates the air quality data reported from local government as one of the indicators of performance or achievement.
- Air quality index didn't include PM2.5 (until 2012), a major pollutant in most Chinese cities.
- In 2011, US Embassy started to publish their self-collected information about air quality on social media like microblog.
- Crowdsensing: some microblog users started were mobilized to collect data themselves
- Local officers were pressed to defend their data.

# Air Quality Crowd Sensing

Images removed due to copyright restrictions. Measuring air quality on smartphones.  
Source: unknown.

# Air Quality Real Time Publication Apps

Images removed due to copyright restrictions. Screenshots of air quality apps.  
Source: unknown.

SID	1
AQI	179
Area	北京
CO	2.7
CO_24h	2.391
ID	510
Latitude	39.8673
Longitude	116.366
NO2	53
NO2_24h	49
O3	76
O3_24h	3
O3_8h	62
O3_8h_24h	21
OrderId	1
PM10	222
PM10_24h	163
PM2_5	200
PM2_5_24h	135
PositionName	万寿西宫
PrimaryPollutant	颗粒物(PM2.5)
Quality	中度污染
SO2	28
SO2_24h	49
StationCode	1001A
TimePoint	2013-02-13T01:00:00
Unheathful	
ICO	27
INO2	27
IO3	1
IO3_8h	11
IPM10	107
IPM2_5	179
ISO2	10

# Air Quality Data Collection and Distribution

- **Traditional Paradigm of Air Quality Data Collection and Distribution**

Images removed due to copyright restrictions.

Source: Figures 2 & 3 in Liu et al. "[Red and Green: Public Perception and Air Quality Information in Urban China](#)." *Environment: Science and Policy for Sustainable Development* 54, no. 3 (2012): 44-9.

# Impact on Information Transparency and Accountability

- Usually difficult to access to official information and data related to urban planning and management
- Data manipulation is common and reliability is always an issue
- Social media like microblog as a platform can increase the public awareness and ignite the debate over controversial topics that of the interest to the most (Air Quality 36,937,163 records, Air pollution 10,446,038 records)
- User-contributed data from crowd-sourcing or crowd-sensing press government to be more transparent and accountable in distributing public information.

## Case 2. Bicycle Sharing Program in Hangzhou



- Initiated by government, operated by public transport agencies
- Launched in 2008, started with 61 stations and 2,800 public bikes
- By 2012, the system is consist of 2,600 + stations and 65,000 + public bikes
- Free for the first hour, 1 RMB (0.16 USD) for the second hour, 2 RMB for the third hour and 3RMB per hour after that.
- Physically separated bicycle lanes on 84% of the secondary and main roads.
- 300,000 + bike sharing trips per day

Images removed due to copyright restrictions. Map of spatial distribution of bike share stations in Hangzhou, and photos of a bike share station.  
Source: unknown.

# Technology

- Third-generation system
  - Integrated circuit (IC) membership card is used for bicycle check-in and checkout.
  - RFID card readers installed on the docks will check the identity and status of shared bikes.
  - Communication between the management terminal and docks through local area network (Ethernet).

Image removed due to copyright restrictions. Photograph of riders at a bike share station.  
Source: unknown.

# Operational Challenges

- Growing pressure on making the program break-even
  - majority of the stations operates between 6AM – 10:30 PM and only keep 55 24-hour stations
  - increasing demand on bicycle repair and replacement

Cost	Revenues
<ul style="list-style-type: none"><li>• 60M-70M RMB (US\$ 9.5 millions – 11.1 millions)</li></ul>	<ul style="list-style-type: none"><li>• Membership fee: 6 million RMB (US\$ 950,000)</li><li>• Advertisement: 30 million RMB (US\$ 4.7millions)</li><li>• Export similar programs to other cities</li><li>• Government subsidy</li></ul>

- Growing complaints from users
  - dock or bike unavailable
  - inconvenient operational hours

# Temporal Patterns

Oct 16, 2012 Tuesday

- Scraping corresponding website every one minute
- Records: station lat/lon, available bikes, available vacant docks, weather condition and timestamp
- min-by-min check-in / check out counts aggregated to every 30 min
- weekday-weekend variation

Oct 21, 2012 Sunday

Images removed due to copyright restrictions. Bar graphs showing bike station checkout and checkin volume on weekdays and weekends.  
Source: unknown.

# Spatial Patterns (Check-out volume)

Oct 16, 2012 Tuesday

Images removed due to copyright restrictions. Maps of spatial patterns of checkout volumes in bike share stations.  
Source: unknown.

Oct 21, 2012 Sunday

# Clustering Results

Images removed due to copyright restrictions. Graphs of clustering results in checkout and checkin volumes at bike sharing stations.

# Cluster 2 Stations

Images removed due to copyright restrictions. Checkout/check-in counts and spatial distributions for a cluster of bike share stations.

	Cluster2	
(Intercept)	0.1784	***
	(0.042)	
Dist_lake	-0.0193	***
	(0.0034)	
Schools	0.0512	***
	(0.0113)	
Intersections	0.0039	***
	(0.0007)	
Neighborhoods	0.0057	*
	(0.0028)	
H_24	0.3548	***
	(0.0545)	
Rho	-0.1664	*
	(0.0966)	
Lambda	0.2515	*
	(0.0906)	
Likelihood Ratio test	6.365	**
Log likelihood:	-418.58	
# observations	1480	
# parameters	9	
AIC	855.15	

# Cluster 3 Stations

Images removed due to copyright restrictions. Checkout/check-in counts and spatial distributions for a cluster of bike share stations.

Cluster3		
(Intercept)	0.2174	***
	(0.0411)	
Dist_cbd	0.0533	***
	(0.0048)	
Dist_nestest_park	0.0417	***
	(0.013)	
Schools	-0.0595	***
	(0.0138)	
Intersections	-0.0038	***
	(0.0008)	
H_24	-0.2981	*
	(0.0678)	
Lambda	0.0491	
	(0.0400)	
Likelihood Ratio test	1.517	
Log likelihood:	-728.48	
# observations	1480	
# parameters	8	
AIC	1473	

# Impact on Urban Management and Public Service

- Real-time data facilitate a more timely and responsive way of providing public service
- Spatial-temporal detailed information helps to further the understanding on spatio-temporal distribution of demand of certain types of public services.
- helps to optimize the supply (the allocation of resources) proactively
- Provides information storage and insights for future plan



# Conclusion

- **Big Data**
  - urban sensing data tell us when, where and how
  - fail to deliver information on who and why
  - big data can be “bad data” (representativeness, completeness, high computational cost, etc)

Image removed due to copyright restrictions. Circular, target-shaped diagram representing big data.  
Source: unknown.

# Conclusion

- **Impacts of Social Media on Planning Process**

- Most social media like Microblog is designed to proliferate themes rather than facilitate discussions

- Good to bring on broader public awareness on hot topics, but not that good on planning issues known best to local community members.

- Search 'Publicizing Plan for Discussion (规划公示)' on the Sina microblog, found 409,279 records.

- Generally received limited attentions (with very few forwards or comments)

# Concluding Remarks

- Rapid urbanization process+ technology development bring both challenges and opportunities to China
- Efforts by the government (state and local), entrepreneurs, academic institutions, NGOs, individual citizens together shape the future of urbanization in China.
- ICT has started and will continue to play an important role in connecting different stakeholders and various facets in urbanization, and there is still a long way to go to build Smart/ Intelligent cities that can improve quality of life for Chinese people.
- Urban planning and management is key in designing, facilitating, and supporting a sustainable future development for Chinese cities.

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