DATA-DRIVEN CITY PLANNING
leveraging “smart city” innovations to promote the integrated planning of sustainable cities

DENNIS LINDERS | UNIV OF MARYLAND & SINGAPORE INTERNET RESEARCH CENTRE | 16 NOV 2013
2013 LIEN CONFERENCE AT SINGAPORE
Rapid Urbanization = One Time Opportunity

We will see an additional 1 million new residents added to cities every week between now and 2050.
SHENZHEN
the “instant city”

...30 years later
Well-functioning cities are engines of prosperity.
...but success is far from guaranteed—we need to be smart about the irreversible decisions we make today
Cities get one shot—cannot afford to get it wrong

cities face not one but many interrelated challenges; this requires a coordinated response, which requires careful planning…
5.1.3 Urban planning

Planning and urban management in Vietnam rather than facilitating the fluid functioning of land and housing markets is still overly based on static design principles. In order to ensure that Vietnam’s cities continue to play a catalytic role in the country’s economy, planning processes and agencies need reform. Policy priorities would focus on improving integration and effectiveness of planning agencies, moving from static to dynamic plans, using sharper tools to better monitor real changes taking place in the land and housing markets in real time. Vietnam would be well advised to consider complementing its master-planning approach with more frequent strategic planning updates, and adaptive management strategies based on current socio-economic data and real market trends to complement and lead design oriented development. This will facilitate better integration of overall planning with other planning processes (such as socio-economic development plans and land use plans).

This proposal is not revolutionary. Most master plans around the world are largely ignored (even in China). In Vietnam, master plans are often referred to as “hanging plans,” suggesting that they often decorate the walls of planning departments but are rarely implemented. As in most countries, Vietnam line agencies typically make investment decisions based on their own population projections, which are rarely consistent with master plans and often differ between agencies. Changing the planning process to be more in line with market dynamics would lead to better and more consistent development outcomes.
PROBLEMS WITH PLANNING

**BRANCH (1981):** Plans are too often disconnected from reality, based not on evidence and emerging trends but on wishful thinking and old assumptions.

**COMPLEXITY:** Every planning process is embedded in a larger social, ecological, economic, political, and administrative setting that must all be taken into account.

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**BRANCH:** Government planning focuses too narrowly on producing long-range, infrequently updated paper-based plans rather than treating planning as a continuous process.

**COMPLEXITY:** Radical shift in viewing cities not as physical artefacts to be designed but as organisms that evolve in ways that can be influenced but not controlled.

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**BRANCH:** Plans are too often developed in isolation within siloed government bureaucracies—completely disconnected from other plans and planning processes—and thereby fail to facilitate collaboration and integrated action.

**COMPLEXITY:** Cities are shaped by the actions and plans of many interconnected organizations and individuals as they pursue their own well-being—this can maybe be coordinated but not, usually, (or effectively) coerced.

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“plans are worthless—but planning is everything” —US President Eisenhower
IMPROVING THE COLLECTION, ANALYSIS, AND SHARING OF PLANNING INFORMATION IS THE KEY TO SUCCESS
Smart City as a Data Collector
• A city is a complex system of systems, and each of these systems generates data. We can analyze this data to make cities smarter.

Smart City as an Integrated System
• Bringing together data from across government empowers leaders to adopt new holistic management approaches that treat their cities as an integrated system.

Smart City as a Platform for Collaboration
• Open data and ubiquitous connectivity enable smart cities to provide mechanisms for real-time, many-to-many information exchange and coordination at city-wide scale.

ADVENT OF “SMART CITIES”

Integrated City Data Streams
- Satellite Imagery
- Built environment
- Natural environment
- Climate
- GIS
  - Digitized administrative records
  - Performance data (e.g., Crime, Health)
- Government statistical offices
- Citizen relationship database
- Assets management system
- Open data

Connected citizens
- 311 system and call centers
  - SMS and mobile apps
  - Mobile phone signals
  - E-government interaction
  - Consultations and office visits

Instrumented and connected infrastructure
- Metering (energy, water, etc.)
  - Environmental sensors
  - Weather systems
  - Cameras
  - Traffic flow
  - GPS tracking
  - Building data

Information management systems

Remote Observation
Data-Driven City Mgmt
“In God We Trust, Everyone Else Bring Data!”

Smart Urban Infrastructure
#1 Green City in Asia (Siemens)

Collaborative “Smart City” Initiatives
Explicit link btw “Smart City” and “Sustainability” initiatives

Sustainability is inherently quantitative (“lower emissions by x percent”); multi-agency; and cross-sectoral
Fig. 1: 2011 New York City Energy Use and Greenhouse Gas Emissions

**Source Energy (1,056 Petajoules)**

- Natural Gas: 583 PJ
- Nuclear: 156 PJ
- Hydroelectric: 6.9 PJ
- Wind & Other Renewables: 1.4 PJ
- Coal: 123 PJ
- Petroleum: 296 PJ

**Direct Use of Natural Gas:** 13.8 million MgCO₂e

**Greenhouse Gas Emissions (53.4 Million MgCO₂e)**

- Residential Buildings: 19.7 million MgCO₂e
- Commercial Buildings: 11.2 million MgCO₂e
- Industrial & Institutional Buildings: 8.5 million MgCO₂e
- Public Transit: 1.4 million MgCO₂e
- On-road Transportation: 9.7 million MgCO₂e
- Landfills, Wastewater Treatment, etc.: 2.9 million MgCO₂e

**Fugitive Emissions:** 2.9 million MgCO₂e

Source: NYC Mayor’s Office
SMART CITY AS INTEGRATED SYSTEM
Coordinate the actions of city’s vast bureaucracies + synthesize plans of individual agencies into unified strategy
"look at our physical environment in a wholly integrated way" focused on implementation and metrics

Remain “nimble, and adjust flexibly to changes in technology and in the global environment”

Avoid “paper tigers” that “disappear into a bottom drawer”
Ensuring a constant, transparent link between aspirations + implementation

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Description</th>
<th>Target</th>
<th>Resource</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>127 initiatives</td>
<td></td>
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</tbody>
</table>
SMART CITY AS PLATFORM FOR COLLECTIVE ACTION
Meeting city-wide goals requires a “WHOLE OF SOCIETY” approach. The city is promoting environmental awareness and action among more than 2 million Singaporeans through community-based programs (CDC’s).
Together we can

Understand the scope of the challenge

Reduce transportation emissions

Reduce emissions from buildings

Update codes and standards
Social media, ubiquitous connectivity, and open data enable information sharing, collaboration, and shared accountability on a scale we have not seen before.

Leverage smart city innovations to inspire and coordinate individual environmental actions towards city-wide sustainability goals.
“Cities should be planned less like centralized mainframes and more like the decentralized Web” (Townsend 2013) put it in the hands of everyone
<table>
<thead>
<tr>
<th>Scope</th>
<th>New York</th>
<th>Amsterdam</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td>City-Level</td>
<td>NYC OpenData</td>
<td>amsterdamopen data</td>
<td>data.gov.sg</td>
</tr>
<tr>
<td>City-Level</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>National</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Datasets</td>
<td>1100+ datasets</td>
<td>120+ datasets</td>
<td>9000+ datasets</td>
</tr>
<tr>
<td>Environment + Energy Data</td>
<td>40 datasets</td>
<td>8 datasets</td>
<td>188 datasets</td>
</tr>
<tr>
<td>Examples</td>
<td>Electricity heatmap, gas consumption, recycle bins, waste collection tonnage, sustainability indicators</td>
<td>Energy usage by postcode, gas usage, air quality</td>
<td>Average electricity usage by dwelling type, electricity grid emissions, Co2 emissions, list of green appliances, flood prone locations, rainfall</td>
</tr>
<tr>
<td>Hackathon</td>
<td>NYC BigApps Competition; Reinvent Green Hackathon</td>
<td>Apps4EU; Amsterdam Hackathon</td>
<td>Apps4Singapore; Energy Efficiency for Everyone Hackathon</td>
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</tbody>
</table>
## Dataset Description

<table>
<thead>
<tr>
<th>S/N</th>
<th>Dataset</th>
<th>Dataset description</th>
<th>Period of data</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anonymised Microdata on Monthly Households Electricity Consumption – Public Housing</td>
<td>Exclusive granular monthly electricity consumption data for individual households in public housing types (1-2, 3-4, 5-room and executive units)</td>
<td>2010-2012</td>
<td>SP, EMA</td>
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<td>Anonymised Microdata on Monthly Households Town Gas Consumption – Public Housing</td>
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<td>2010-2012</td>
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<td>3</td>
<td>Anonymised Microdata on Monthly Households Electricity Consumption – Private Housing</td>
<td>Exclusive granular monthly electricity consumption data for individual households in private housing types (private apartment, executive condo, semi-detached, terrace house &amp; bungalow)</td>
<td>2010-2012</td>
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<td>SP, EMA</td>
</tr>
<tr>
<td>5</td>
<td>Anonymised sample Microdata on Households Half-Hourly Electricity Consumption</td>
<td>Exclusive half-hourly electricity consumption data from a one-off study on a sample group of individual households in Singapore</td>
<td>Aug 2012-Mar 2013</td>
<td>EMA</td>
</tr>
</tbody>
</table>
PUBLIC-PRIVATE-PEOPLE (3P) PARTNERSHIPS

Collaborative “smart city” experiments to reduce carbon footprint
3-WAY OPEN DATA
sharing plans + performance information across society

New York Greener, Greater Building Plan (benchmarking and energy audits data)

Singapore Mandatory Energy Management Practices (energy use, GHG, improvement plans)
SHARED ACCOUNTABILITY
example from NYC data portal
A mathematical model was used to estimate the annual energy consumption values for buildings in NYC.

http://modi.mech.columbia.edu/nycenergy/
Smart City as Opportunity

**Plans are disconnected from reality**

- Leverage “smart city” innovations to obtain vast new streams of data on the performance and state of the city for real-time situational awareness.

**Plans need to respect complexity and uncertainty**

- Unify data from across the city to facilitate integrated planning and leverage innovations in ICT to replace static paper-based planning with a “living” planning information-base accessible by all.

**Plans are disconnected from other plans**

- Facilitate many-to-many information sharing, community-wide action, and day-to-day coordination by leveraging new innovations in open data, social media, and ubiquitous connectivity.
Research Priorities

**Smart City as Data Collector**
- Define the analytical core necessary to inform continuous planning.

**Smart City as Integrated System**
- Examine emerging management practices, structural changes, process re-engineering, and information sharing approaches required to effectively reshape public administration and planning around a data-driven approach.

**Smart City as Platform for Collaboration**
- Design open architectures for federated, cross-sectoral strategic planning and new mechanisms for day-to-day coordination and community-wide information sharing.