SUSTAINABLE SYSTEMS

Building Smarter Cities
Topics

- The global trend toward urbanization
- Core urban systems
- Impact of rapid urbanization
- Sustainable ("smart") cities
- Economic political context
Our framework is the TBL: “people, planet, profit”

In terms of urban environments this becomes: “residents and workers, the environment, and efficiency of operation.”
The global trend toward urbanization

Why do most of us want to live in cities?
Why live or work in an urban environment?

- Economic opportunities *(jobs!)*
- Large, diverse labor pool
- Political power centers *(voters)*
- Religious centers
- Cultural and information centers
- Health care *(specialized)*
- Education *(magnet schools)*
## Largest cities through history

<table>
<thead>
<tr>
<th>Year</th>
<th>City</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>3100 BCE</td>
<td>Memphis, Egypt</td>
<td>30,000+</td>
</tr>
<tr>
<td>2030 BCE</td>
<td>Ur, Babylonia</td>
<td>65,000</td>
</tr>
<tr>
<td>200 BCE</td>
<td>Xian, China</td>
<td>400,000</td>
</tr>
<tr>
<td>25 BCE</td>
<td>Rome</td>
<td>450,000</td>
</tr>
<tr>
<td>1500 CE</td>
<td>Beijing</td>
<td>672,000</td>
</tr>
<tr>
<td>1825 CE</td>
<td>London</td>
<td>5+ mil</td>
</tr>
<tr>
<td>1925 CE</td>
<td>New York</td>
<td>10+ mil</td>
</tr>
<tr>
<td>1965 CE</td>
<td>Tokyo</td>
<td>20+ mil</td>
</tr>
<tr>
<td>2014 CE</td>
<td>Tokyo</td>
<td>38+ mil</td>
</tr>
</tbody>
</table>
Global Urbanization

Building Smarter Cities- 8
Largest urban environments by continent

Africa: Cairo, Lagos
Asia: Tokyo, Jakarta, Delhi, Manila
Australia: Sydney
Europe: Istanbul, Moscow, Paris
N America: New York, Los Angeles, Mexico City
S America: Sao Paulo, Rio de Janeiro, Buenos Aires
## Largest urban environments

<table>
<thead>
<tr>
<th>2015 Rank[1]</th>
<th>2014 Rank</th>
<th>City</th>
<th>Country</th>
<th>Population</th>
<th>Area (km²)</th>
<th>Density (/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Tokyo–Yokohama (Keihin)</td>
<td>Japan</td>
<td>37,843,000</td>
<td>8,547</td>
<td>4,400</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Jakarta (Jabodetabek)</td>
<td>Indonesia</td>
<td>30,539,000</td>
<td>3,225</td>
<td>9,500</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>Delhi</td>
<td>India</td>
<td>24,998,000</td>
<td>2,072</td>
<td>12,100</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>Manila (Metro Manila)</td>
<td>Philippines</td>
<td>24,123,000</td>
<td>1,580</td>
<td>15,300</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>Seoul–Incheon (Sudogwon)</td>
<td>South Korea</td>
<td>23,480,000</td>
<td>2,266</td>
<td>10,400</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>Shanghai</td>
<td>China</td>
<td>23,416,000</td>
<td>3,280</td>
<td>6,100</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Karachi</td>
<td>Pakistan</td>
<td>22,123,000</td>
<td>945</td>
<td>23,400</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>Beijing</td>
<td>China</td>
<td>21,009,000</td>
<td>3,820</td>
<td>5,500</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>New York City</td>
<td>United States</td>
<td>20,630,000</td>
<td>11,642</td>
<td>1,800</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>Guangzhou–Foshan (Guangfo)</td>
<td>China</td>
<td>20,597,000</td>
<td>3,432</td>
<td>6,000</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>São Paulo</td>
<td>Brazil</td>
<td>20,365,000</td>
<td>2,707</td>
<td>7,500</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>Mexico City (Valley of Mexico)</td>
<td>Mexico</td>
<td>20,063,000</td>
<td>2,072</td>
<td>9,700</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>Mumbai</td>
<td>India</td>
<td>17,712,000</td>
<td>546</td>
<td>32,400</td>
</tr>
</tbody>
</table>
Core urban systems

What are the critical functions and support systems that urban dwellers depend upon?
Core urban systems

- Built environment
- Energy
- Governance: management
- Healthcare access
- Infrastructure: water, gas, electric
- Mobility
- Security: police, fire
- Technology: communications
Smart Cities

They use a command and control perspective.

- Can measure the state of things
- Can assemble and process the data
- Can make decisions based on data
- Can implement the decisions
Smart energy

- Smart generation
- Smart grids
- Smart meters
- Intelligent energy storage
- Intelligent allocation
Smart infrastructure

- Sources of fresh water
- Water distribution networks
- Water metering and flood alerts
- Water management
- Solid waste management
Smart buildings and space

- Building automation
- Advanced HVAC
- Intelligent lighting
- Internet of “things”
- Repurposing space
## Smart mobility

- Advanced traffic management systems
- Parking management
- ITS-enabled transportation pricing system
Impact of rapid urbanization

What are some of the effects of rapid urbanization?
Rapid urbanization

• Rapid rate of urbanization is overwhelming response efforts

• Population shifts affect economic and environmental systems

• Population size and distribution can affect socio-political stability
Negative impacts of rapid urbanization on shelter

- Inadequate planning, poor housing and slum conditions
- Poor sanitation and limited access to clean water
- Vulnerability to natural disasters
- Safety and security are poor
Negative impact of rapid urbanization on road traffic

- Traffic congestion cost an estimated $78 billion in 2008 for the U.S. alone

- An estimated 50% of greenhouse gas emissions are from cars

- 4.2 billion hours lost in transit
Negative impact of rapid urbanization on air quality

- 1/3 of green-house gas emissions come from buildings
- 1/3 come from urban transportation
What makes a city smarter?
An Early Example of Urban Planning in US

Philadelphia
The City of Brotherly Love, founded in 1682 by William Penn, a Quaker
Global Smart City Market Analysis

“Strategic Opportunity Analysis of the Global Smart City Market”

FROST & SULLIVAN

M920-MT, August 2013

This is a widely cited report. One good summary is the article “Smart Cities – A $1.5 Trillion Market Opportunity”, S. Singh, Forbes 6/19/14
Some companies working with cities

- IBM
- GE
- ABB
- Schneider Electric
- Siemens AG

- Cisco
- Accenture
- Oracle
- Ericsson
- Johnson Controls
IBM’s Intelligent Operations Center

The IBM IOC monitors and manages city services.

- Water
- Transportation
- Public safety
- Energy
- Buildings
- Healthcare
- Government
### IBM’s dashboard

#### Key Performance Indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Distribution, Flood Control, Waste, Quality</td>
</tr>
<tr>
<td>Transportation</td>
<td>Subway, Rail, Bus, Road/Traffic</td>
</tr>
<tr>
<td>Public Safety</td>
<td>Police, Fire, EMS, Management, Support</td>
</tr>
<tr>
<td>Energy</td>
<td>Maintenance, Disruptions, Sustainability, Support</td>
</tr>
<tr>
<td>Buildings</td>
<td>Public Buildings, Public Housing, Energy, Sustainability</td>
</tr>
<tr>
<td>Healthcare</td>
<td>Prevention, Disruptions, Home Visits, Bio Surveillance</td>
</tr>
<tr>
<td>Government</td>
<td>Family Services, Housing Authority, Economic Dev, Public Schools</td>
</tr>
</tbody>
</table>

*Note: The dashboard visualizes performance indicators across various categories with color coding for acceptability levels.*

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Smart Grid for electricity

- Uses many sources for generation
- Tracks usage in great detail
- Can use current most efficient source
- High density of use and local generation offer big efficiency gains
Urban Pollution Abatement

- Higher-density cities
- Carbon caps on car emissions
- More efficient mass transit
- LEED certified buildings / Green buildings
- Green roofs
- Renewable-energy municipal buildings
Repurposing space

Underground park: before
Underground park: after
Economic political context

- Sources of government funding
  - Federal
  - State
  - Local
- US congressional representation
- Mayors’ Conference
US representatives by state

Based on 2010 census.
## Congressional representation by state

<table>
<thead>
<tr>
<th>N</th>
<th>State</th>
<th>POP (K)</th>
<th>#SEN</th>
<th>POP/SEN</th>
<th>#REP</th>
<th>POP/REP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CA</td>
<td>39,145</td>
<td>2</td>
<td>19573</td>
<td>53</td>
<td>739</td>
</tr>
<tr>
<td>2</td>
<td>TX</td>
<td>27,469</td>
<td>2</td>
<td>13735</td>
<td>36</td>
<td>763</td>
</tr>
<tr>
<td>3</td>
<td>FL</td>
<td>20,271</td>
<td>2</td>
<td>10136</td>
<td>27</td>
<td>751</td>
</tr>
<tr>
<td>4</td>
<td>NY</td>
<td>19,796</td>
<td>2</td>
<td>9898</td>
<td>27</td>
<td>733</td>
</tr>
<tr>
<td>5</td>
<td>IL</td>
<td>12,860</td>
<td>2</td>
<td>6430</td>
<td>18</td>
<td>714</td>
</tr>
<tr>
<td>46</td>
<td>ND</td>
<td>757</td>
<td>2</td>
<td>379</td>
<td>1</td>
<td>757</td>
</tr>
<tr>
<td>47</td>
<td>AL</td>
<td>738</td>
<td>2</td>
<td>369</td>
<td>1</td>
<td>738</td>
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<tr>
<td>48</td>
<td>DC</td>
<td>672</td>
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<td>336</td>
<td>0</td>
<td>inf</td>
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<tr>
<td>49</td>
<td>VT</td>
<td>626</td>
<td>2</td>
<td>313</td>
<td>1</td>
<td>626</td>
</tr>
<tr>
<td>50</td>
<td>WY</td>
<td>586</td>
<td>2</td>
<td>293</td>
<td>1</td>
<td>586</td>
</tr>
</tbody>
</table>

Pop based on 2015 data. Rep based on 2010 census.
Mayors Conference (USA)

The organization serves the following functions:

- develop effective national urban/suburban policy;
- build more effective federal-city relationships;
- monitor federal policy in terms of urban needs;
- help mayors develop management tools;
- provide a forum in which mayors can share ideas and information.

en.wikipedia.org/wiki/United_States_Conference_of_Mayors
By representing all large municipalities and their leaders …, the conference is speaking for vast majority of the components of the nation's economy. According to one of the Conference's own reports, metropolitan areas accounted for 84 percent of the nation's gross domestic product and at the same time generated 84 percent of the nation's employment opportunities.

en.wikipedia.org/wiki/United_States_Conference_of_Mayors
Mayors Conference (USA)

Standing Committees
- Children, Health and Human Services
- Community Development and Housing
- Criminal and Social Justice
- Energy
- Environment
- International Affairs
- Jobs, Education and the Workforce
- Membership
- Metro Economies
- Tourism, Arts, Parks, Entertainment and Sports
- Transportation and Communication
Thanks For Listening!