Smart | Digital Cities and Eco-Districts

*Data, Technology and Urban Innovation*

*from*

*Buildings to Urban Scale and Beyond*

Stephen R Hagan FAIA

President | CEO

Hagan Technologies
Agenda

• Smart Digital Cities
• Emerging Technologies
  – Case Studies: Technology and Urbanism
• Virtual 3D Cities & Eco-Districts
• Data and the Facility and Urban Life Cycle
• Events and Initiatives
• Key Principals and Take Aways
Agenda

Data
Smart Digital Cities
2012 TED Prize Given To The City 2.0

The Huffington Post  |  By Conor White-Sullivan  |  
Posted: 03/01/12 11:40 AM ET  |  Updated: 03/01/12 01:38 PM ET  

facebook  |  41 likes. Sign Up to see what your friends like.
Smart City Barcelona

Barcelona Smart City 2015

What is a Smart City? A Smart City is one that, through public-private collaboration, improves the efficiency of the city, betters the quality of life of its citizens, and grows the local economy.

- Smart Living
  - Vancouver: 48% of residents born outside Canada

- Smart Government
  - Lima: 80% Government Services are online

- Smart Mobility
  - Montreal: 5,000 Bikes shared, 1,300 Cars shared

- Smart People
  - Copenhagen: 75% Residents own a smartphone

- Smart Environment
  - Singapore: 2,155 Certified green buildings

- Smart Economy
  - Brisbane: Sustainable innovation program for public-private collaboration

How Smart is Barcelona?

- Europe Innovation Capital of 2014
- Mayor Bloomberg Innovation Challenge Winner 2014
- BCN Open Challenge: crowdsources solutions for 6 major city problems

CityBikes app, App&Town, SCS info built thanks to Open Data of the City

IoT trash cans report their status in real-time

Appark8 and Bicing encourage Smart Mobility

Smart City Campus: Innovation Area to promote synergies and innovation in urban solutions

10 - 11 August, 2015
Bethesda North Marriott Hotel & Conference Center, USA

GeoBIM
Smart City Barcelona

Some Key Players in Barcelona

- **BCN SMART CITY**
  - 32+ Ongoing Smart City initiatives

- **Schneider Electric**
  - 16 million euros pledged to the Smart City Campus in Barcelona

- **UPC**
  - 120+ research and innovation projects related to smart cities lead by UPC

- **Cisco**
  - 28 million euro investment committed to the Smart City Campus Barcelona

- **Smart City Expo World Congress**
  - 11,000 visitors, 440 cities, and 275 companies present in the 2014 edition of the annual exposition

- **Smart City Campus & Diagonal Besós - 22@**
  - 230,500 m² floor space for a cluster devoted to promoting research and pilot programs in Smart Cities

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GeoBIM
Berlin Business Atlas
The Age of Cities

BOHAI REGION: 200+ MILLION POPULATION

10 - 11 AUGUST, 2015
BETHESDA NORTH MARRIOTT HOTEL & CONFERENCE CENTER, USA

GeoBIM
NIST US Ignite Global Cities Team Challenge

**AMERICA'S MAIN STREET**

*AN INTERACTIVE EXPERIENCE*

- **Smart Streetlights**
  - Sensor, camera
  - Measuring crime, reduce energy
- **Smart Parking**
- **1-2 Block Initial Implementation**

*Holographic Sessions*

**GeoBIM**

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Overlap

Operations and Maintenance

Programming and Animation

Planning, Design and Economic Development

Governance

NCPC Penn. Ave. Program
The Issue | Operations + Maintenance

Infrastructure and furnishings along the Avenue are aging.
The BID’s Streetscape App. | Operations + Maintenance

- The BID has a GIS streetscape elements app. to identify maintenance issues, and report them to 311 Online. Can we build on that app. to develop a universal O&M maintenance application?

- Yes with a cost
The Federal Facilities Management Group has a FM app. to identify Building issues, and report though a central database. Can we re-purpose on that app. to develop a universal O&M maintenance application?

Maybe we need to explore...
Can the Avenue serve a demonstration project, using the SmartLights as a global sensor network to create Smart Streets concept. Create a showcase of maintenance and active technology the IoT that engenders the aspiration statements innovative spirit. Solve energy, transportation, operations, maintenance, and other Smart Streets issues.
Emerging Technologies
Innovative Dynamic Path-Breaking Technologies

- Augmented Reality
- Big Data and Analytics
- BIM
- CAFM
- Capturing Reality
- Cloud Computer
- CMMS
- Cybersecurity
- Data Storage
- Digital Fabrication
- Fog Computing
- Gamification
- Geo-Spatial | GIS
- Ibeacon
- Internet of Things (IoT)

- Laser Scanning
- Messaging (email, sms, and beyond)
- Mobile
- Model Checking
- Pervasive Computing
- Sensors
- Simulation
- Social Networking and Media
- Specification Authoring
- Synchronization
- Virtual Reality
- Wearable Computing
Technology Becoming Transparent
Case Studies: Technology and Urbanism
Smart Cities and Big Data

BIG DATA, CIVIC HACKERS, AND THE QUEST FOR A NEW UTOPIA

SMART CITIES

ANTHONY M. TOWNSEND

10 - 11 AUGUST, 2015

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Istanbul and Improving Public Transit

• Insights in Motion: Deep Analytics Shows How Cities Really Work

• Potential:
  – Reduce Transit Operating Expenses by 40%
  – Meet 37% More demand
  – Reduce Average Commuter Time by 60%
  – Reduce Per Travel Combustion Emissions by 40%
How We Picture a City: Venice and Google Maps

In Street View mashups, we see not just clever Photoshopping, but two cultures' ways of seeing a place.

ROBINSON MEYER | MAR 3 2014, 12:01 PM ET

Venice, according to Canaletto and Google Street View (shystone)
Walk Score

Washington D.C. is the 7th most walkable large city in the U.S. with a Walk Score of 73.

Washington D.C.'s most walkable neighborhoods are Dupont Circle, West End, and Downtown.

Washington D.C.
- Walk Score: 73
- Transit Score: 69
- Average Rent: $1,906
- Population: 601,568

Walk Score Distribution

Washington D.C. Neighborhoods

Washington D.C. is the 7th most walkable city in the U.S. with a Walk Score of 73. In Washington D.C., 60% of residents have a Walk Score of 70 or above.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Walk Score</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dupont Circle</td>
<td>98</td>
<td>14,443</td>
</tr>
<tr>
<td>2</td>
<td>West End</td>
<td>97</td>
<td>3,204</td>
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<tr>
<td>3</td>
<td>Downtown</td>
<td>96</td>
<td>4,181</td>
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</table>
https://livabilityindex.aarp.org/

Livability Index | Great Neighborhoods for All Ages

How **livable** is your **community**?

![Webpage](https://livabilityindex.aarp.org/)

The Livability Index scores neighborhoods and communities across the U.S. for the services and amenities that impact your life the most.
Virtual 3D Cities & Eco-Districts
Virtualcitysystems.de
Old “analogue” technology: Wood model of Shanghai
The SW Ecodistrict
A VISION PLAN FOR A MORE SUSTAINABLE FUTURE

National Capital Planning Commission

JANUARY 2013
What is an Ecodistrict?

Energy Today

Where does the energy come from?

Coal generated electricity
Natural Gas
Cogeneration Plant (burns natural gas)
Renewable Energy

SW Ecodistrict Goal

Strive for a zero net energy district (the energy the district needs is produced from renewable resources within or close to the district)
<table>
<thead>
<tr>
<th>Building Information</th>
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<tbody>
<tr>
<td>Building ID</td>
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<tr>
<td>Building Name</td>
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<tr>
<td>Site Area</td>
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<tr>
<td>Parking Spaces</td>
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<tr>
<td>Building Areas</td>
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<tr>
<td>Building Occupancy</td>
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<tr>
<td>Utilities Summary</td>
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</tbody>
</table>

[Image of Building Diagrams and Building Details]
Further Improving That Visualization...
Data and the Facility and Urban Life Cycle
Hong Kong Population: 7,055,071
Water: 2.63 Million Cubic Meters Per Day
Energy: 805 Terajoules Per Day
Facility Life Cycle Data
Events and Initiatives
Global City Teams Challenge – (SmartAmerica Round Two)

Cyber-physical systems (CPS) involve connecting smart devices and systems—in diverse sectors such as transportation, energy, manufacturing, and healthcare—in fundamentally new ways. These "Internet of Things" technologies will enable cities and communities to improve services, promote economic growth, and enhance the quality of life. With 54 percent of the world's population now living in cities, the development of "smart cities" and "smart communities" is becoming a major focus around the globe.
NYT Cities for Tomorrow

The New York Times

CITIES FOR TOMORROW
CONFERENCE

BJARKE INGELS on Social Infrastructure

WATCH NOW

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Smart City Innovation Awards 2015: all the winners

Marco Morini with the startup SBskin is the winner of the first edition of Smart City Innovation Awards 2015, the competition on "cities of the future" organized in Milan by BNL - Gruppo BNP Paribas in collaboration with the non-profit organization MIT Enterprise Forum.

Academic spin-off of the University of Palermo, SBskin is a startup that develops technologies for maximizing energy efficiency of buildings with no impact on their aesthetical aspect, by using innovative building products that provide insulation and use solar energy. As winner of Smart City Innovation Awards 2015, the founder of SBskin, Marco Morini, will go to Boston to participate in EmTech 2015, the most important international conference on emerging technologies that will be held from 2 to 4 November 2015 at MIT Media Lab.
SimCity Rochester

A $6.5 billion plan to create a city-sized biotech hub looks a lot like SimCity
Cities as a Lab

What can we learn from cities that have a history of innovation and success? Cities as a Lab provides insights, case studies, and ideas that offer policy and design solutions for buildings and neighborhoods that help build next-generation economies. Read the report: 10 MB PDF for screen or 10 MB PDF for print

(Cover photo by Chad Ress.)
Learn more about innovative cities

Global Innovation Index

The Atlantic Cities: CityLab

Brookings Institute: The Metropolitan Revolution

MIT Center for Advanced Urbanism

CNU Sprawl Retrofit bibliography

Rockefeller Foundation: 100 Resilient Cities
The Vision for Digital Cities

- City
- Public
- Designer
- Utility
- Dev

Visualization
Simulation
Analysis

Digital City

Aggregate
data from multiple sources

Simulate
visualize and simulate outcomes

Collaborate
share internally and externally

- Mapping
- Building
- Civil
- Utilities

Smart Cities & Innovation
Governance & Social Capital
The Share Society

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GeoBIM
Smart Cities and Sustainability, ARUP City Systems

Example: Systems monitoring
How can smart city technology make better cities?

Example: Urban Energy modeling

Smart Cities and Sustainability: Example Chicago, building energy consumption
Analyzing Digital Cities

Building level design:
- Air Flow
- Sunlight
- Winds
- Solar Radiation

Smart Cities & Innovation

GeoBIM

Smart Cities and Information Modeling

10 - 11 August, 2015

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The Smart City Concept:

Ecological systems
As part of comprehensive plans
The US Gov issued Rebuild by Design, an unprecedented call to action to not only repair... but also to better preventative measures and encourage collaboration across agencies.

The Smart City Concept:

Ecological systems

The AIA National Honors Awards 2015 Urban Design

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Digital city modeling
The Smart City Concept:

Emergencies
Justice
Education
Maintenance
Clean Air
Energy
Resilience
Sustainability
The Smart City Concept:
Ecological systems
The AIA National Honors Awards 2015 Urban Design

Water & Urban Design

A REGIONAL PLAN
The Greater New Orleans Urban Water Plan integrates infrastructure planning and urban design across three hydrological basins. It proposes a new investment model for public works, wherein spending on streets, canals, pump stations, and stormwater detention basins enhances public spaces that are vital to life in the region, and yields opportunities for economic growth and development. The Urban Water Plan is a comprehensive vision for the region in the 21st century, built on each basin’s history, geology, and geography, as it is on shared challenges and opportunities.
A Location Framework for Smart Cities

Mark Reichardt
President & CEO
mreichardt@opengeospatial.org
+1 301 840-1361
Urban environments are complex

OGC standards offer a platform to integrate 2D and 3D geospatial information, including indoor and sensor data to create the *Spatial Information Infrastructure of a Smart City.*
2D or 3D, Geospatial Information Underpins Smart, Safe, Resilient Cities
Smart Cities Spatial Information Themes

- Smart Cities are high-density generators of innovation and information
- Location information is a major enabler of Smart Cities
- Benefits of smart technology must be judged by benefits to residents
- Reuse and repurpose is vital to urban resilience
- Open standards are needed for interoperability, efficiency, application innovation and cost effectiveness.

(Graphic from Steve Liang, University of Calgary)
What’s so smart about Smart Cities?

• A Smart City provides effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.
  – Source: BSI PAS 180 - Smart Cities Vocabulary
Indicators for city services and quality of life

What are standardized indicators?
Quantitative, qualitative or descriptive sets of measurements and metrics that provide a globally standardized set of definitions and methodologies.

Who are the users of ISO 37120?
This International Standard is applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location or level of development.

How can ISO 37120 help cities?
Standardized indicators enable cities to assess their performance and measure progress over time and also to draw comparative lessons from other cities locally and globally. They also help to guide policy, planning and management across multiple sectors and stakeholders.
OGC Focus – 3D Urban Models


- Utilities - Smart Grid, Smart Water, etc.
- Sanitation
- Intelligent Buildings
- Intelligent Transportation
- Health
- Public Safety and Security
- Environmental Protection
- Emergency Services
- Education
- Urban Planning
- Telecommunications
- Open Data, Citizen Services
- Many other uses…

www.virtual-berlin.de
OGC CityGML: An urban gospatial information integration standard

Training City Services staff
CityGML: Solar Energy Production Potential Analysis

[Image: A screenshot of a solar atlas showing solar panel installations in Berlin, with details on photovoltaic suitability and energy production for a specific building.]

**BLDG_0003000a000afa2d**

**Photovoltaic suitability**

**Address:** Albertstr. 14, Berlin

**Available area for photovoltaic installations:** 139.20 m²

**Average solar radiation in a year:** 1126.30 kWh/m²

**Solar electricity yield:** 18.81 MWh/a

**Maximal installable power:** 19.90 kW/m²

**CO₂ Savings:** 11.74 t per year

**Investment volume:** 69,650 €

[Website: http://www.businesslocationcenter.de/solarpotential]
European Commission Climate Action 2030

- 40% reduction in greenhouse gas emissions from 1990 levels
- Increase renewable energy to at least 27%
- Increase energy efficiency by 27% - 30%

Urban Resilience and Energy Delivery

- Water Resources
- Climate Change
- Extreme Weather

Weather Related Grid Disruptions

Source: U.S. ENERGY SECTOR VULNERABILITIES TO CLIMATE CHANGE AND EXTREME WEATHER
Climate Change and the need for Urban Resilience

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Urban Agglomeration</th>
<th>Exposed Assets Current ($Billion)</th>
<th>Exposed Assets Future ($Billion)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>Miami</td>
<td>416.29</td>
<td>3,513.04</td>
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<td>2</td>
<td>CHINA</td>
<td>Guangzhou</td>
<td>84.17</td>
<td>3,357.72</td>
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<td>3</td>
<td>USA</td>
<td>New York-Newark</td>
<td>320.20</td>
<td>2,147.35</td>
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<td>4</td>
<td>INDIA</td>
<td>Kolkata (Calcutta)</td>
<td>31.99</td>
<td>1,961.44</td>
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<td>5</td>
<td>CHINA</td>
<td>Shanghai</td>
<td>72.86</td>
<td>1,771.17</td>
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<td>INDIA</td>
<td>Mumbai</td>
<td>46.20</td>
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<td>7</td>
<td>CHINA</td>
<td>Tianjin</td>
<td>29.62</td>
<td>1,231.48</td>
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<td>8</td>
<td>JAPAN</td>
<td>Tokyo</td>
<td>174.29</td>
<td>1,207.07</td>
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<td>9</td>
<td>CHINA,</td>
<td>Hong Kong</td>
<td>35.94</td>
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<td>THAILAND</td>
<td>Bangkok</td>
<td>38.72</td>
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<td>Ningbo</td>
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<td>JAPAN</td>
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<td>Amsterdam</td>
<td>128.33</td>
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<td>Rotterdam</td>
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<td>VIETNAM</td>
<td>Ho Chi Minh City</td>
<td>26.86</td>
<td>652.82</td>
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<td>19</td>
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<td>Virginia Beach</td>
<td>84.64</td>
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<td>20</td>
<td>EGYPT</td>
<td>Alexandria</td>
<td>28.46</td>
<td>563.28</td>
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</tbody>
</table>

Table 2: Top 20 cities ranked in terms of assets exposed to coastal flooding in the 2070s (including both climate change and socioeconomic change) and showing present-day exposure (Source: Nicholls et al (2007), OECD, Paris)

Developing a Smart Cities Spatial Standards Framework
Developing a Smart City Spatial Standards Framework

- **Geography Markup Language (GML)** – the international XML standard for spatial data on the web.

- **CityGML** - open data format for the storage and exchange of virtual 3D city models and semantics

- **IndoorGML** - modeling indoor spaces for navigation purposes.

- **InfraGML** - civil engineering and survey data for land development and transportation

- **Building Information Models (BIM)** Using BuildingSmart, ISO and OGC standards

- **Sensor Web Enablement (SWE)**
OGC CityGML Adoption

• Europe
  – European INSPIRE (Infrastructure for Spatial Information in Europe)

• The Netherlands National 3D standard
  – CityGML part of Dutch 3D Standard

• CityGML based urban Models:
  – Berlin, Germany and other cities
  – U.A.E. – Abu Dhabi
  – Kingdom of Bahrain
  – Finland
  – Singapore
  – Austria (Vienna, Salzburg), France (Paris), Switzerland (Geneva)
Interoperability Services for Smart Cities

- **Geospatial Data - OGC Web Service Standards**
  - Integrate and share all types of geospatial and remote sensing data about a city

- **Sensor feeds - Sensor Web Enablement Standards**
  - Discover, Task, Access and Process Observations from all types of sensors

- **Leverage Social Media / Crowdsourcing**
  - Geo-enabled Social Media
  - SensorThings for Internet of Things

- **Support Analysis and Processing**
  - Model city processes

- **Visualization and Augmented Reality**

- **Open Data and Mobile Applications:**
Smart City Standards Emphasis - Mobile

- Geotagged SMS messages
- Augmented Reality Markup Language (ARML) 2.0
- Points of Interest

- 3D Visualization
- Indoor Navigation (IndoorGML)
- Sensors / Internet of Things (IoT)

Augmented Reality Markup Language 2.0 (in development). Source: Wikitude

IndoorGML

OGC W3DS
In Google Earth
(Chicago)
Source:
Standards Coordination for Smart Cities

- ISO/IEC JTC 1/SG 1 Smart Cities
- ISO TMB Task Force on Smart Cities
- ITU Focus Group on Smart Sustainable Cities
- ISO ISO/TC 268 - Sustainable development and resilience of communities
- British Standards Institute
- DKE/DIN German standards
- Others: IEC, ANSI, CEN/CENELEC, ETSI, etc.
An OGC Framework for Smart Cities

• “OGC Smart Cities Spatial Information Framework”
  – https://portal.opengeospatial.org/files/?artifact_id=61188

• Influenced by:
  – OGC’s geospatial, sensor, processing, mobile standards work
  – Survey of Smart City Standards Activities:
    • JTC 1, ITU, ISO, BSI, DIN, others
  – Survey of OGC CityGML implementations

• Goal: Advance an OGC Best Practice for Location Enabled Smart Cities
Key Principles and Take Aways
Data Layer and Data Service

App A  App B  App C  App D

Data Service

Data
Modular vs. Monolithic
Lessons from Storm Sandy: When Hospital Generators Fail

In the wake of superstorm Sandy, much of New York City was plunged into darkness. What happened to the patient?

By Alexandra Sifferlin @acsifferlin | Oct. 30, 2012 | 5 Comments

Resiliency of Facility Data Directly Impacts the City

Hospital workers evacuate patient Deborah Dadlani from NYU Langone Medical Center during Hurricane Sandy the evening of Oct. 29, 2012 in New York City.

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Buildings to Urban Scale and Beyond

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