



CENTER FOR TECHNOLOGY IN GOVERNMENT  
UNIVERSITY AT ALBANY State University of New York

# Building Smarter Cities: Trends, Research and Lessons Learned

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**Center for Technology in Government, University at Albany**

**NYS AMPO**

**June 20, 2017**



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# About Me

- An applied researcher in public sector innovation for 20 years
- Focus is on technology, management, and policy in government
- Expertise in county, city and municipal governments throughout NYS, the US, and the world





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The mission of the Center for Technology in Government at the University at Albany is to foster public sector innovation, enhance capability, generate public value, and support good governance.



Theresa Pardo & J. Ramon Gil-Garcia discuss "Making Cities Smarter" in Rockefeller College's 15 in 2015 Who are Transforming Public Affairs. [More>>>](#)

## THREE PRIORITIES

Knowledge Creation

Information Dissemination

Capacity Building



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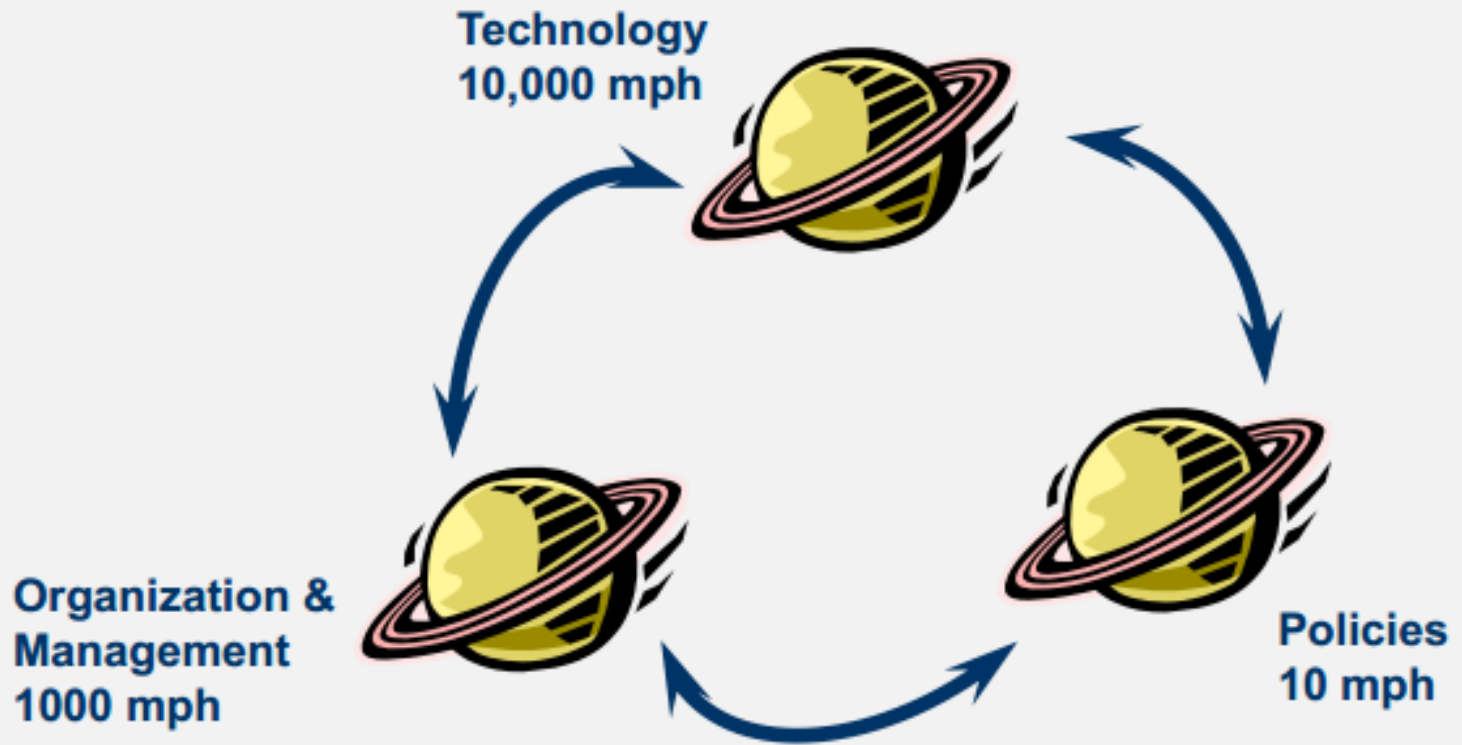


**CTG is a globally focused center with partners and projects from around the world**





# Why We Do What We Do



# ANATOMY OF A SMART CITY

*"The 19th century was a century of empires, 20th century was a century of nations and the 21st century will be a century of cities."*

- Former Denver Mayor

**THE WORLD IS NOW URBAN**  
...in cities



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# What is a city?

“...cities are systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness and optimization at every level of system integration”

*Source: Smart Cities Group, MIT*



# The Small Get Bigger

“While mega-cities have captured much public attention, most of the new growth will occur in smaller towns and cities, which have fewer resource to respond to the magnitude of change.”

*Source: United Nations Population Fund*





# The Smallest City: Hum, Croatia



Population: 23

Source: Guinness Book of Records

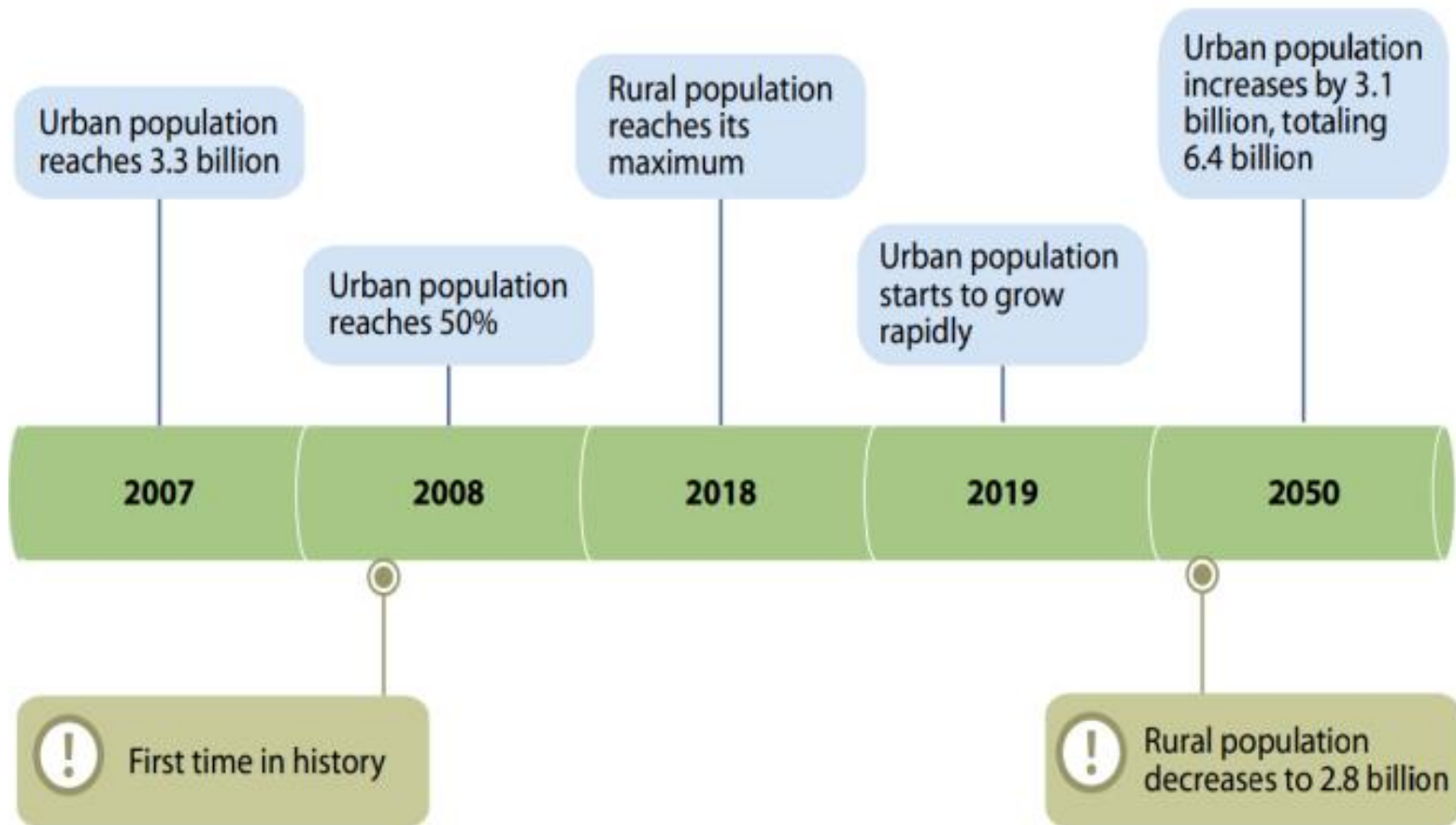


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# Why Getting *SMART* Matters



Source: Forrester Research, Inc.



# Why Getting *SMART* Matters

## Physical problems arising from rapid urbanization

- Loss of basic functionalities to be a livable place
- For example, difficulty in waste management, scarcity of resource, air pollution, human health concerns, traffic congestion, inadequate, deteriorating and aging infrastructures and so on.

## Social and organizational problems, rather than technical, physical or material problems

- Concerns associated with multiple diverse stakeholders, high levels of interdependence, competing values and social and political complexity
- Wicked and tangled problems



The key to urban success  
live, work and play





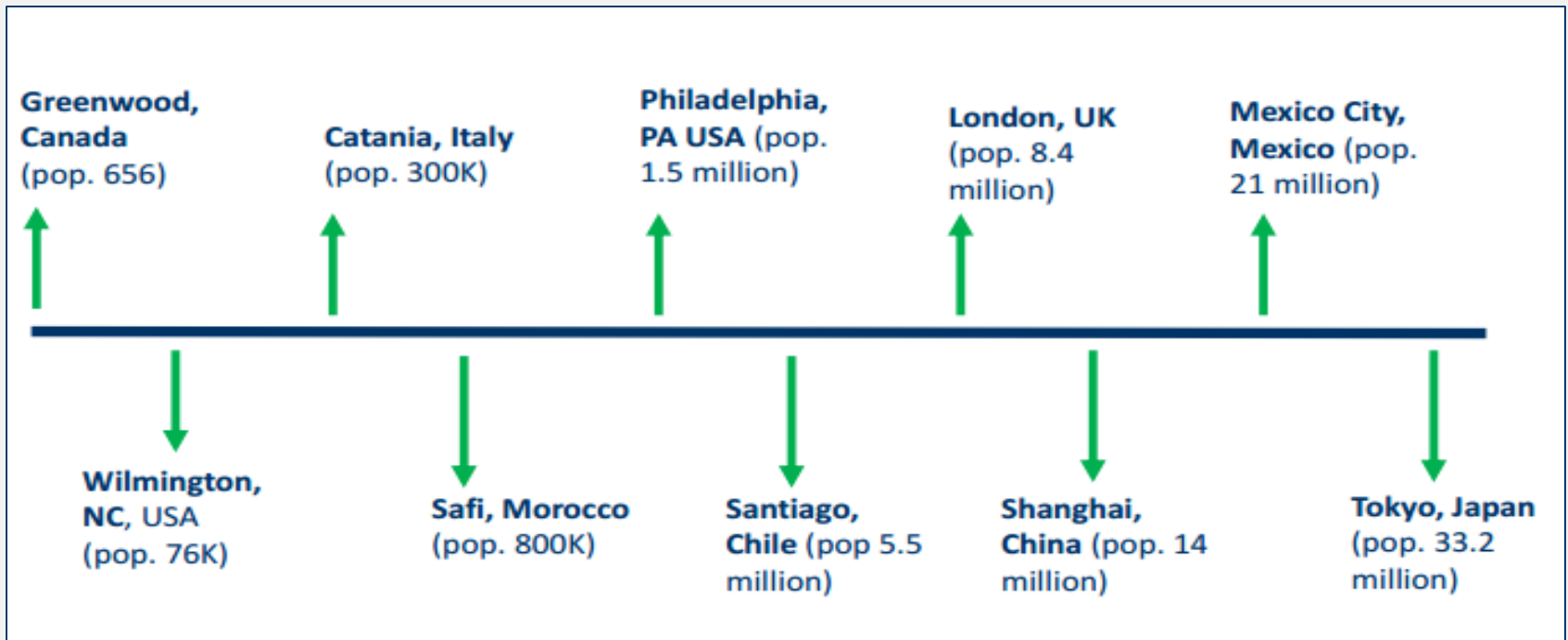
# Differing Community Contexts...

**Population**

**Geographic  
Span & Type**

**Diversity,  
Culture,  
Ethnicity**

**Community  
Leadership**



**Industry**

**Workforce**

**Government  
Structure &  
Leadership**

**Tax Base**



# An Emerging Issue

Small to medium sized cities are finding it more challenging (than the mega cities) to deliver innovative programs and services to their citizens and effectively engage in the full range of economic and community development initiatives that will result in them being a “smart city”



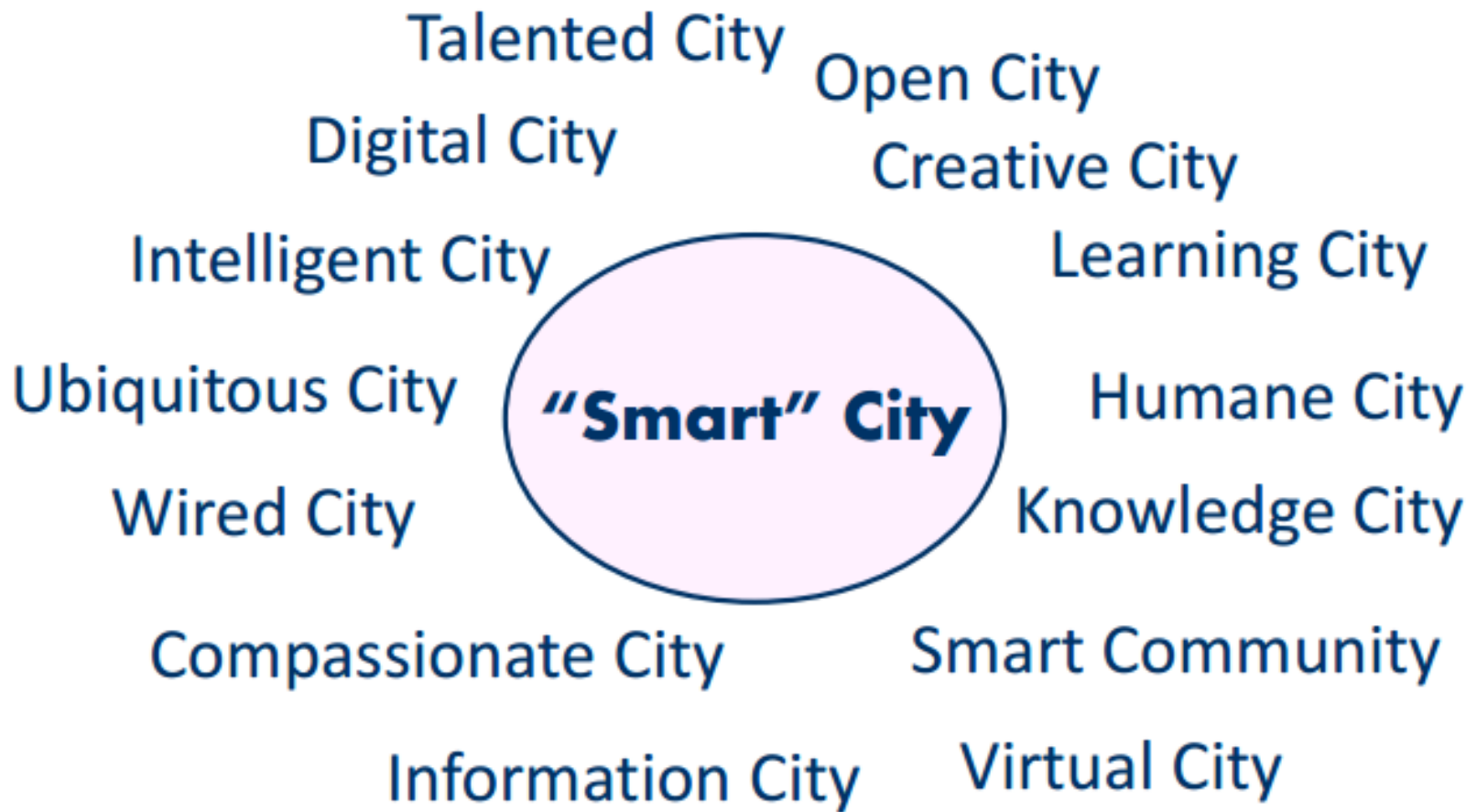
# What is a Smart City?

No agreed-upon description of what  
“smart” implies in the context of a city

*Source: Chourabi et al, 2012*



# Conceptual Relatives of a Smart City



# **“A city is smart when....**

**...investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.”**

*Source: Caragliu, Del Bo, & Nijkamp, 2009*



# “A smart city...

...looks at all the **exchanges of information** that flow between its many different subsystems. It then **analyzes this flow of information** as well as of services and acts upon it in order **to make its wider ecosystem more resource-efficient and sustainable.**”

*Source: Velosa III et al., 2010*





# **“A smart city is....**

**...well performing in a forward-looking way in economy, people, governance, mobility, environment and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.”**

*Source: Giffinger, 2007*



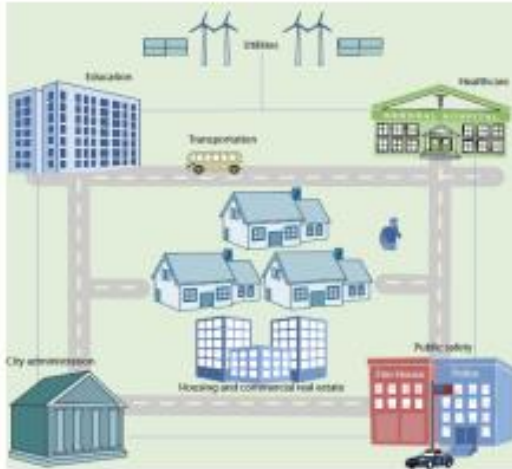
# **“A smart city uses....**

**...smart computing technology to make the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation and utilities – more intelligent, interconnected and efficient.”**

*Source: Washburn et. al. 2010*



## Forrester Research's Smart City Blue Print



## Gartner's Smart City Platform



## IBM's Smarter City Framework



## Intelligent Community Forum's Indicators



# Urban Sustainability Directors Network



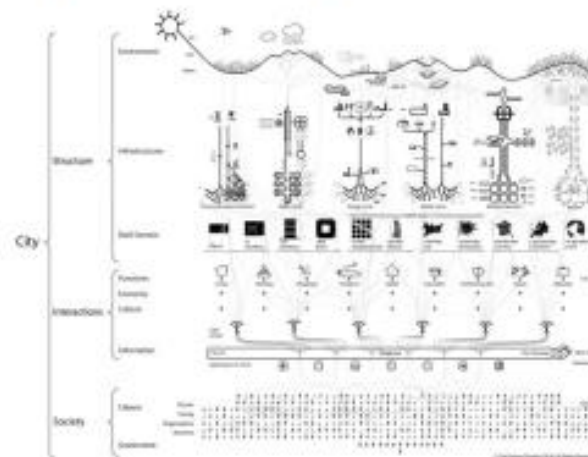
# 100 Resilient Cities City Resilience Framework



# US Smart Cities Council Readiness Guide



# City Protocol Society City Anatomy Framework



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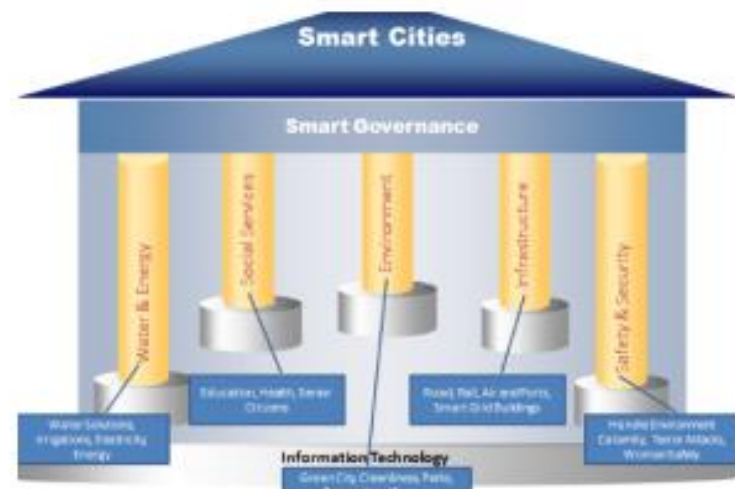
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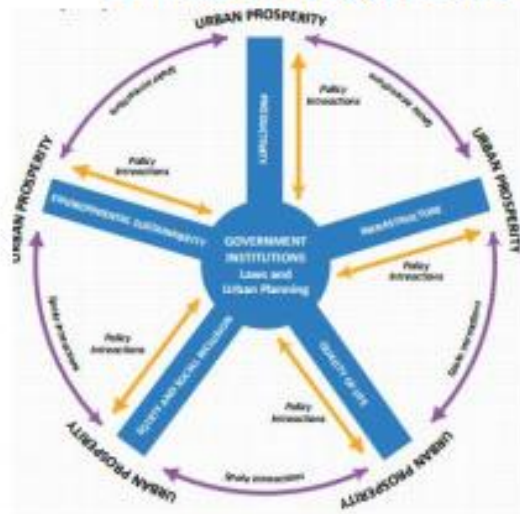
## Cisco Smart City Framework Layers



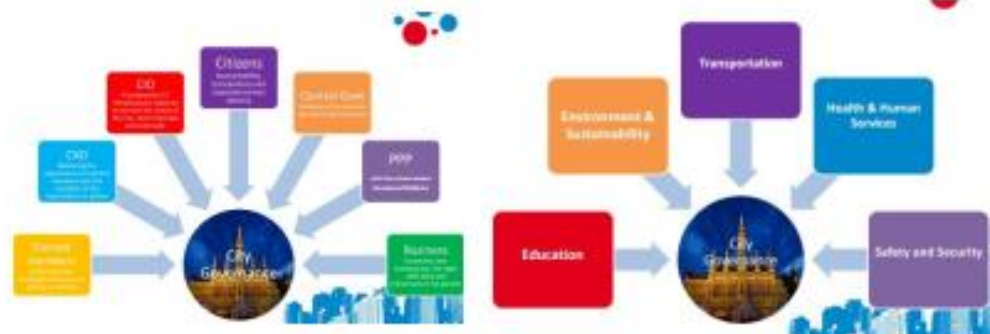
## SAP Future Cities Framework



## City Prosperity Wheel United Nations



## Microsoft Connect Smart Cities Framework





# An Analysis

**Are there common components of a smarter city?**

A review of:

- Academic Literature
- Private Sector Platforms
- Non-profit Approaches



## TECHNOLOGY

• Broadband and wireless infrastructure  
• Virtual technologies • Ubiquitous infrastructure  
• Computing network  
• Service-oriented architecture

ICT &  
OTHER TECHNOLOGIES

### NATURAL ENVIRONMENT & ECOLOGICAL SUSTAINABILITY

- Ecological sustainability
- Monitoring system
- Pollution control
- Attractive natural conditions

### BUILT ENVIRONMENT & CITY INFRASTRUCTURE

- Environmental and economic sustainability
- Functional management
- Attractiveness

## PHYSICAL ENVIRONMENT

### KNOWLEDGE ECONOMY & PRO-BUSINESS ENVIRONMENT

- Knowledge economy
- High-tech industry
- Creative, entrepreneurial industry
- Business-friendliness

### HUMAN CAPITAL & CREATIVITY

- Creative class
- Social infrastructure
- Higher education
- Skilled and knowledge workforce

## SOCIETY

### GOVERNANCE, ENGAGEMENT, & COLLABORATION

- E-governance
- Network, partnership, and collaboration
- Stakeholder, citizen, and community engagement

### INSTITUTIONS

- Institutional type and form
- Rule of law
- Intergovernmental agreements

### CITY ADMINISTRATION & MANAGEMENT

- E-government
- Performance management
- Funding
- Staffing
- Leadership
- Vision
- Policy instrument
- Policy learning

## GOVERNMENT

### PUBLIC SERVICES

- Transportation
- Public safety
- Health and social services
- Housing
- Water
- Energy and electricity
- Solid waste
- Shelter
- Emergency management
- Food
- Culture, tourism, and recreation

## CTG's Smarter Cities Framework



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**So what might “smart” look like??**



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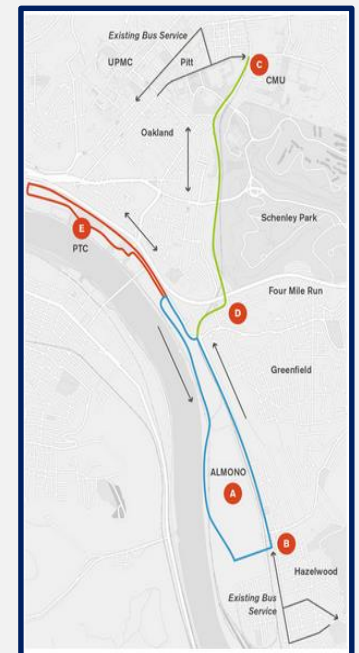
# Pittsburgh, PA

Population 304K

- Autonomous Shuttle Network
- Partnering with US DOT, Carnegie Mellon University, and Uber
- Connects the net-zero energy ALMONO site in Hazelwood with the Oakland neighborhood and Downtown reducing flooding in those neighborhoods and enabling accessible, energy-efficient transportation.



SOURCE: <https://www.almono.org/vision>



SOURCE:  
<http://smartpittsburgh.org/programs/autonomous-shuttle-network>

# Palo Alto, California

Population 67K

**Civic Technology Center** is the home of the City of Palo Alto's Technology department and a destination that more closely resembles and performs like the start-up community in which we serve today. It is an environment that fosters collaboration, ideation, creativity, and co-creation. It's a new way of doing government technology.

## WHAT IS THE CTC?

The Civic Technology Center (CTC) is the home of the City of Palo Alto's Technology department. But it is also much more than that. The CTC is a destination that more closely resembles and performs like the start-up community in which we serve today. It is an environment that fosters collaboration, ideation, creativity, and co-creation. It's a new way of doing government technology.



### MEET

The CTC is used as a meeting space for getting things done. Smart boards help capture brilliant ideas while digital displays communicate the most pressing initiatives the team are working on.



### CREATE

The CTC is a location for co-creation and ideation. The space can be used as a place to brainstorm ideas for civic technology opportunities and building a better future for our city. With vibrant colors, lounge seating, and built-in brainstorming tools to take



### COLLABORATE

The CTC provides temporary residency for stakeholders to co-create the future with City staff. It is the intersection where public and private partnerships are developed. The open floor plan allows for rich collaboration and conversation with staff.



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# Dublin, Ireland

## Population 1.1 million



- This traffic management system uses sensors at traffic intersections to detect how many vehicles are in each lane, as well as the numbers of pedestrians.
- Traffic lights can then be adjusted dynamically to respond to congestion. In the event of road traffic incidents, they can manually override automatic traffic lights to intervene and alleviate congestion.
- The data generated is being used to develop and deploy new technologies to further automate and detect anomalies and black spots in the roads network.

### TRAFFIC MANAGEMENT CENTRE

29/02/2016

Keeping Dublin moving.

The Dublin Traffic Management and Incident Centre is a single control room in a secret location that handles traffic management for the Greater Dublin Area.



• Powered by 130 CCTV cameras located across the city, the M50 and in neighbouring local authorities, this traffic management system uses sensors at traffic intersections to detect how



# Oakland, California

Population 406K

“The Sustainable Oakland program, housed in Environmental Services, supports Oakland’s progress in becoming a more sustainable”

- Reduced greenhouse gas (GHG) emissions 14% since 2005
- Reducing water use in its municipal operations
- Homeowners and commercial property owners can finance energy efficiency, water efficiency and renewable energy projects at low cost.

## Becoming a more sustainable city...



...a community in which all people have the opportunity to pursue safe, happy, healthy and fulfilling lives, now and into the future

### Sustainable City Vision



#### Economic Prosperity

Oakland has a thriving, diverse, and sustainable economy, offering a variety of active business and employment opportunities. The City continuously works to enhance the local business climate to attract, grow, and retain businesses, and to create jobs for residents. Local workforce development networks are helping to develop skills and expertise among residents and businesses to succeed in the evolving global economy. Oakland also offers support to help local businesses grow in their operations, improve energy efficiency, and save money.



#### Health, Safety & Wellbeing

The City and its partners work to create and maintain a healthy, safe, and fulfilling environment for all residents and visitors. Local efforts aim to address inequities in access to healthy lifestyle choices and healthcare services. All members of the Oakland community have a role to play in creating a vibrant and resilient community by making healthy choices, using smart preventive practices, and helping to build supportive environments.



#### Natural Resources, Waste & Environmental Health

Oakland is located in a region abundant with natural resources upon which we rely for food, water, energy, raw materials, recreation, and respite. Natural resources are limited, and some are threatened by the impacts of urbanization. City policies related to creek protection, waste, climate change, land use, and other issues are designed to protect the health of our natural environment and make the best use of natural resources.



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# Fort Lauderdale, Florida

Population 172K

- GoLauderdale mobile app puts it all at your fingertips. The app makes it easy to pick the perfect hotel, find your way to the newest waterfront restaurant, or plan a day of kayaking

## Attract more tourists with augmented reality (like Fort Lauderdale)

Tue, 2015-12-15 10:58 — Kevin Elzi

Source



### Augmented Reality

In augmented reality—like Google Glass or the Yelp app's Monocle feature on mobile devices—the visible natural world is overlaid with a layer of digital content.



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# Bellevue (and 21 other cities), Washington

## Population 1.5 million

- The *eCityGov Alliance* was formed by nine cities (pop 135K to 6K) to form an inter-local agency with a mission of *providing convenient and consistent online services to the public*.
- The services are aligned in a consistent manner, providing simple, easily-accessed municipal services and deployed from a regional perspective so that each city and their citizens accesses the services at reduced costs.





# Santander, Spain

Population 175K

Since 2010, 12,500 sensors have been placed in and around the city's downtown district...

- Measuring everything from the amount of trash in containers, to the number of parking spaces available, to the size of crowds on the sidewalks.
- Sensors on vehicles such as police cars and taxicabs measure air pollution levels and traffic conditions.





# Shawnee, Kansas

Population 64K



- Shawnee is one of the more crowded markets for broadband service in the US.
- Time Warner Cable, AT&T U-verse, Google Fiber, and Consolidated Communications all offering wired internet access to major parts of the city.
- These providers use a variety of wired technologies including cable, DSL, and fiber.
- 100% of residents can choose from 2 or more wired providers

| CABLE             | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 18 MBPS  |
|-------------------|-----------------|--------------|---------------------------|----------------------|
| Time Warner Cable | ★★★★☆           | 99.9%        | 100 <small>Mbps</small>   | \$34.99              |
| DSL               | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 18 MBPS  |
| AT&T U-verse      | ★★★★☆           | 93.7%        | 45 <small>Mbps</small>    | \$45.00              |
| FIBER             | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 100 MBPS |
| Google Fiber      | ★★★★★           | 92.5%        | 1,000 <small>Mbps</small> | \$50.00              |
| CABLE             | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 18 MBPS  |
| Consolidated      | ★★★★☆           | 84.4%        | 100 <small>Mbps</small>   | \$14.95              |
| FIBER             | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 18 MBPS  |
| Consolidated      | ★★★★☆           | 28.2%        | 1,000 <small>Mbps</small> | \$25.00              |
| FIBER             | CUSTOMER RATING | AVAILABILITY | FASTEST SPEED             | PRICING FOR 18 MBPS  |
| AT&T U-verse      | ★★★★☆           | 20.0%        | 45 <small>Mbps</small>    | \$44.95              |

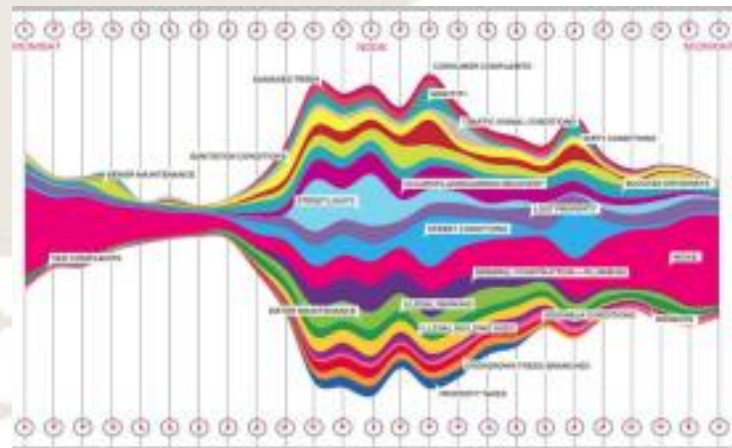
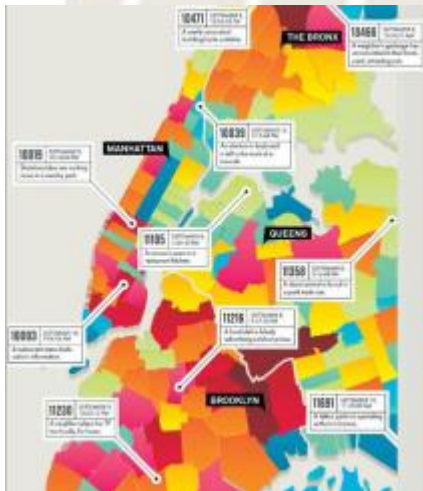


# New York City, New York

## Population 8.4 Million

- Centralized Citizen Communication
- Service Integration Platform
- Data and Analytics Hub

**Spatial  
Analysis of  
Service  
Requests**



**Temporal  
Analysis of  
NYC 311  
Service  
Requests**



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# Kansas City, Missouri

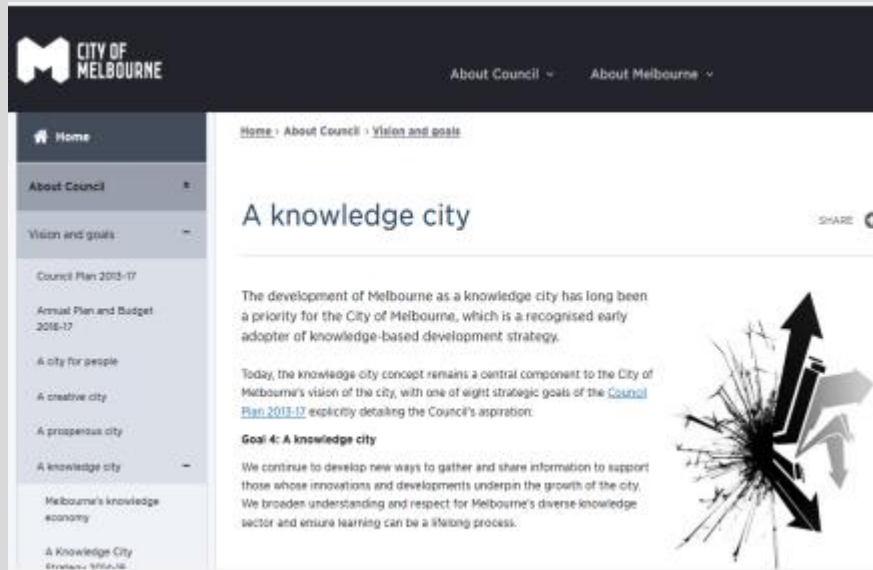
## Population 467K

- The streetcar is the first step in a longer-range plan to create a regional, integrated transit system
- Public WiFi network – 3 miles of downtown
- Smart Kiosks provide residents and visitors with access to many types of information about entertainment and services.



# Melbourne, Australia

## Population 4 Million



The knowledge sector cuts across all segments of the economy through several knowledge-intensive activities such as design, consulting and analytical work.



Creators, transferers and intensive users of knowledge and their activities and outputs – whether technical (engineering based), symbolic (art and culture based) or analytical (science based).



# Dubuque, Iowa

## Population 58K

### Water Management

- Smarter Sustainable Dubuque project conducted in conjunction with the City's community-wide water meter replacement project.
- Smarter Water Portal provided a customer-specific, integrated view of water usage. The data was collected hourly and transmitted daily. Usage data was displayed in gallons, cost, or by carbon footprint. The portal also provided leak detection and notification, historical usage data, and comparative data.







# **What We've Learned From Working In This Space**



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# Align With Your Values and Goals



## **Economic Value**

income, asset values,  
liabilities, entitlements,  
risks to these

## **Social Value**

family or community  
relationships, social  
mobility, status, identity.



## **Political Value**

personal or corporate  
influence on  
government &  
politics.



## **Strategic Value**

economic or political  
advantage or  
opportunities, goals,  
resources for  
innovation or planning.

**Determine the  
Public Value of Each  
Investment**

## **Stewardship Value**

public's view of  
government officials as  
faithful stewards.

## **Quality of Life Value**

security, health,  
recreation,  
personal liberty



## **Ideological Value**

alignment of beliefs,  
moral or ethical  
values with  
government actions  
or outcomes.



# Be Open to Guidance....



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# Pay Attention Privacy and Security



## NOT JUST A STREET LIGHT

City street lights are so ubiquitous they often go unnoticed. Today, street lights do more than just illuminate urban spaces. Fitted with multiple sensors and beacons, street light infrastructure becomes a hub for capabilities ranging from environmental to public safety to transportation and more.

### URBAN SECTORS

- TRANSPORTATION
- UTILITIES
- TELECOM
- GOVERNMENT SERVICES
- ENVIRONMENTAL

### STAKEHOLDERS

**INDIVIDUAL**  
Citizens and visitors enjoy improved quality of life, including safer, more efficient services, seamless interfaces, and responsive institutions. Individuals' data fuels new services and infrastructure.

**GOVERNMENT**  
Local governments become more transparent, inclusive, responsive, efficient, and innovative. Data from connected sensors fuels a plethora of infrastructure, services, and activities.

**BUSINESSES**  
Companies and civic organizations explore new business opportunities, improve products and services, and promote research and innovation based on access to new, real-time, reliable urban data flows.

**PUBLIC-PRIVATE PARTNERSHIPS**  
PPPs improve the quality, reliability, speed, diversity, and sustainability of city service and solutions. Technologies and data flows enable individuals, governments, and businesses to collaborate in real time.

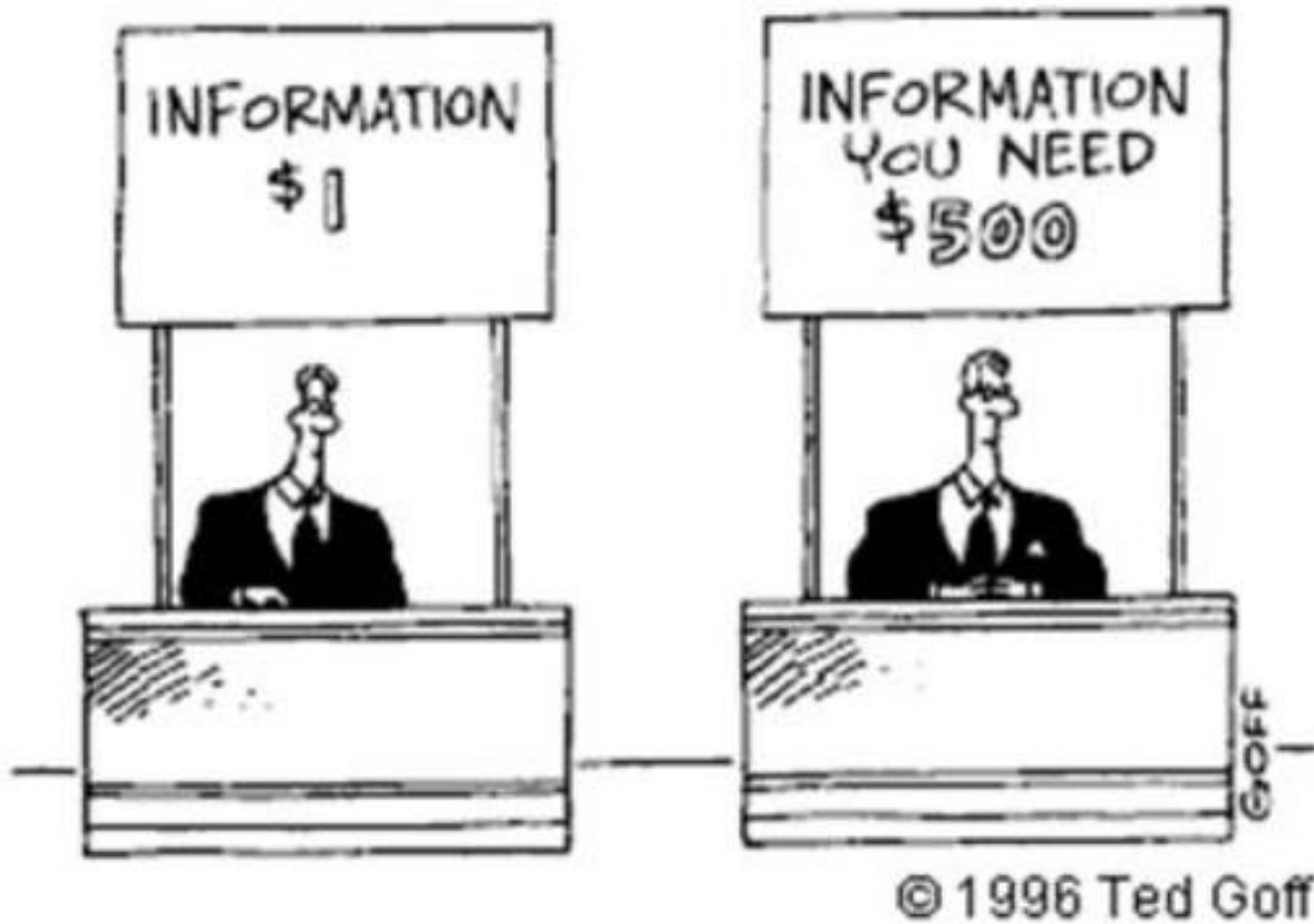


# Identify and Build the Capabilities Necessary to Meet Goals





# Treat Information as a Strategic Asset





1. Working Across Boundaries
2. Everything Related to Data-Mgmt, Leveraging, Privacy, Security, and Opening
3. Including and Engaging Citizens
4. Real Performance Measures For Smarter City
5. Making Failure Encouraged and Acceptable
6. Paying Equal Attention to the Rural Communities
7. Leadership (political & all other types) Within Public Services
8. Artificial Intelligence
9. Ensuring Basic City Services
10. Funding, Resources, and the Market
11. Universal Broadband
12. Agility & Legislation
13. Making Smart Investments in Building Cities
14. Environmental Sustainability



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## Thank you!

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