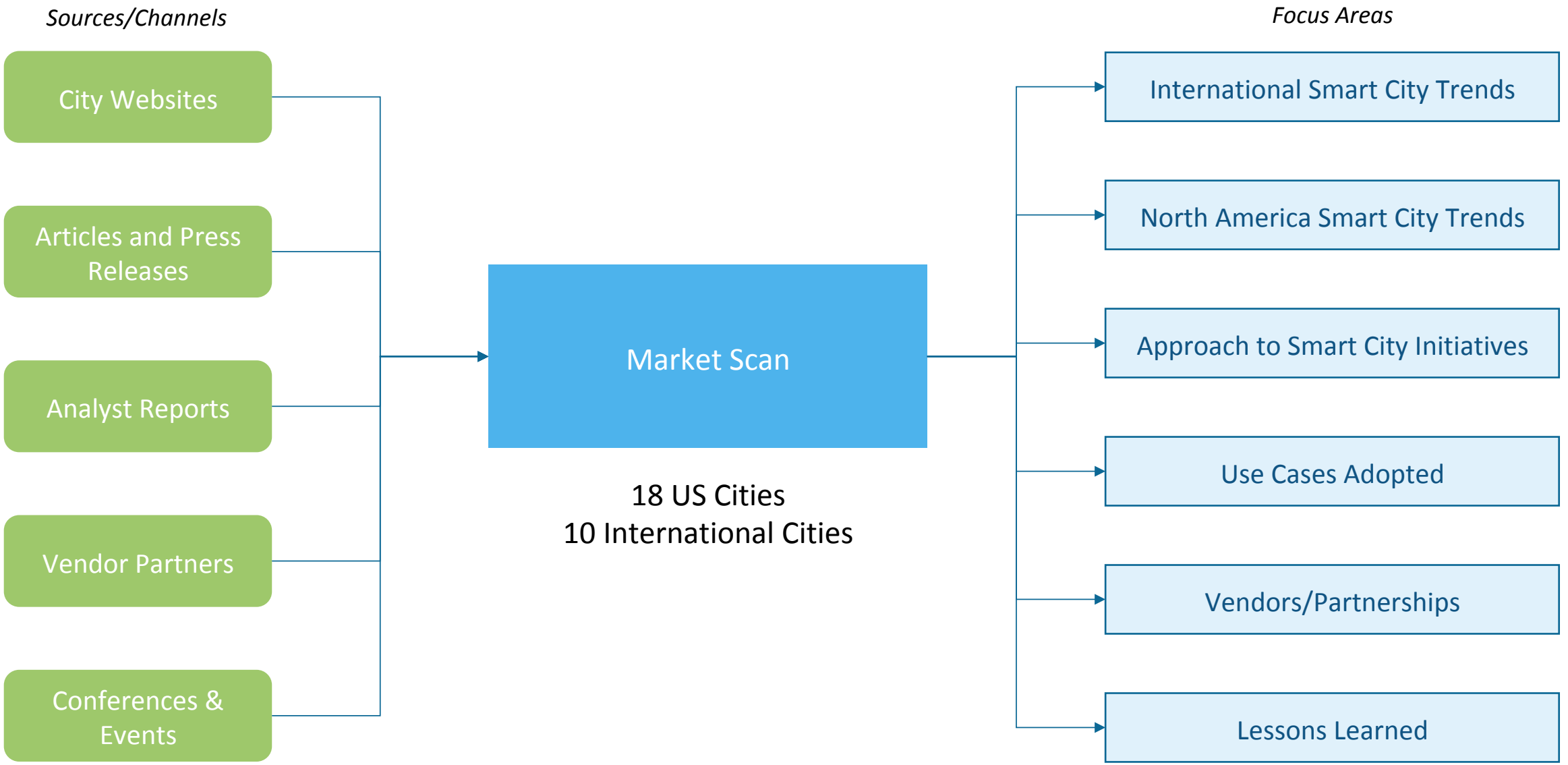
STRATEGY OF THINGS

Smart Cities Market Scan and Best Practices Report

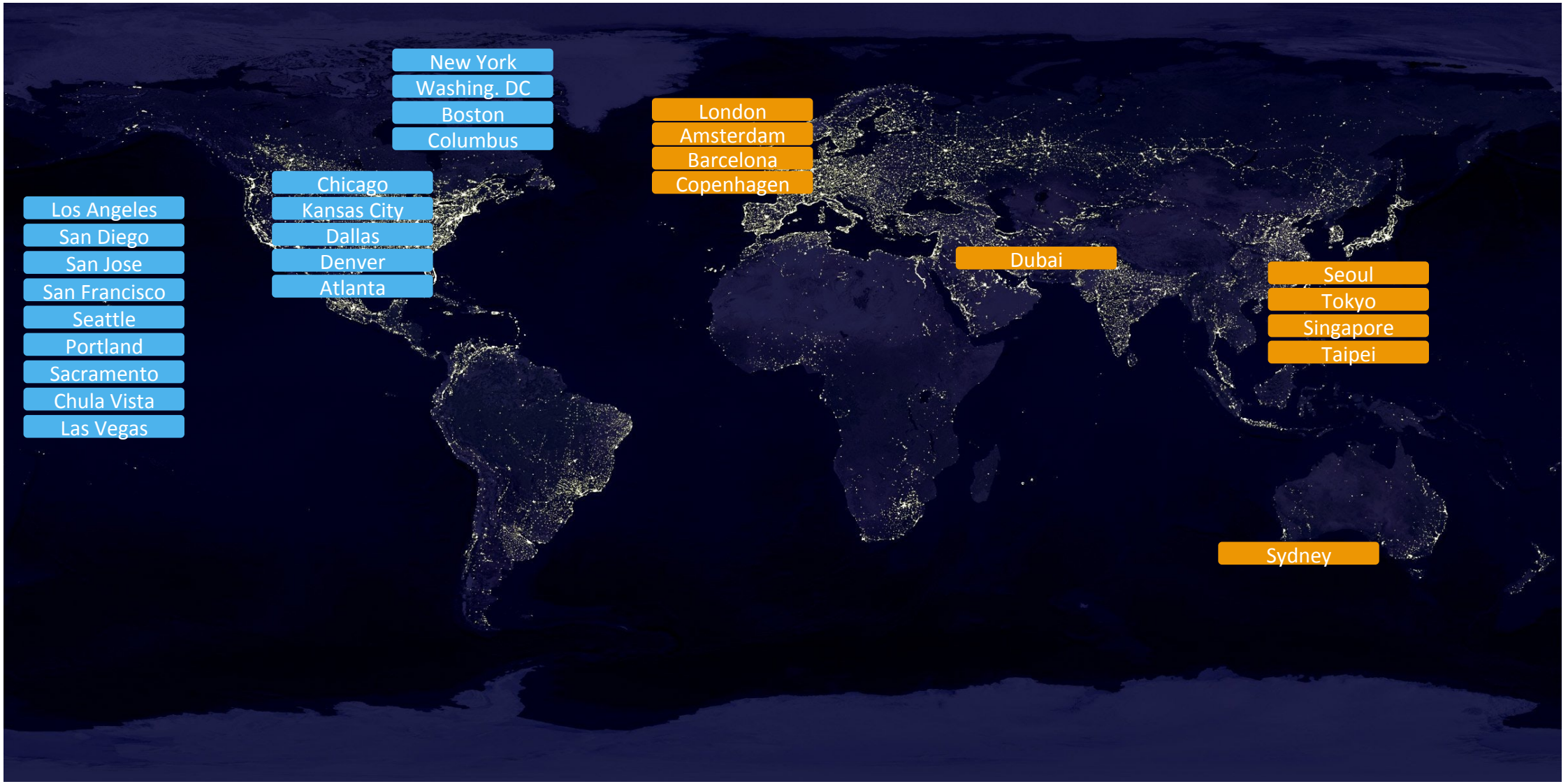
April, 2018

Market Scan Findings

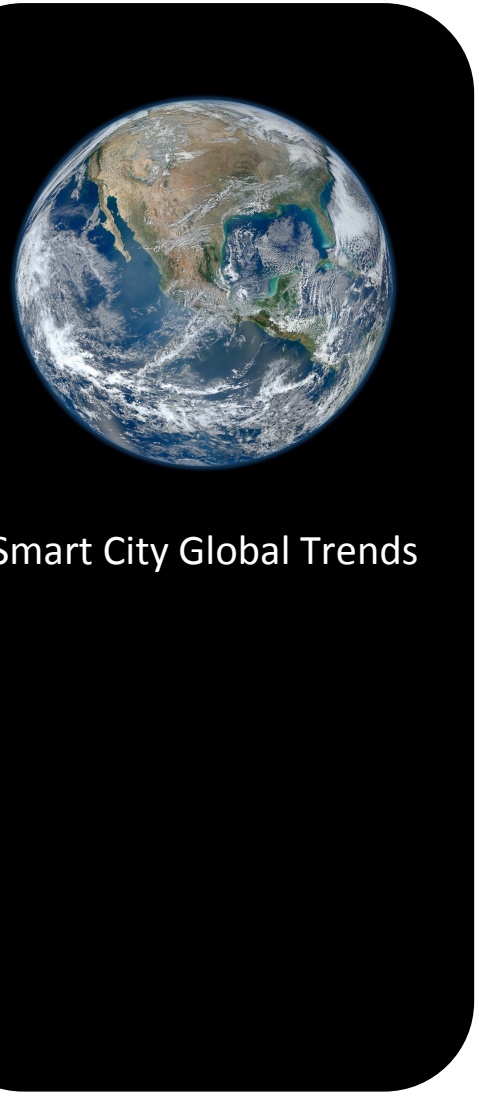
Approach and Methodology



List of International and U.S. Cities Reviewed



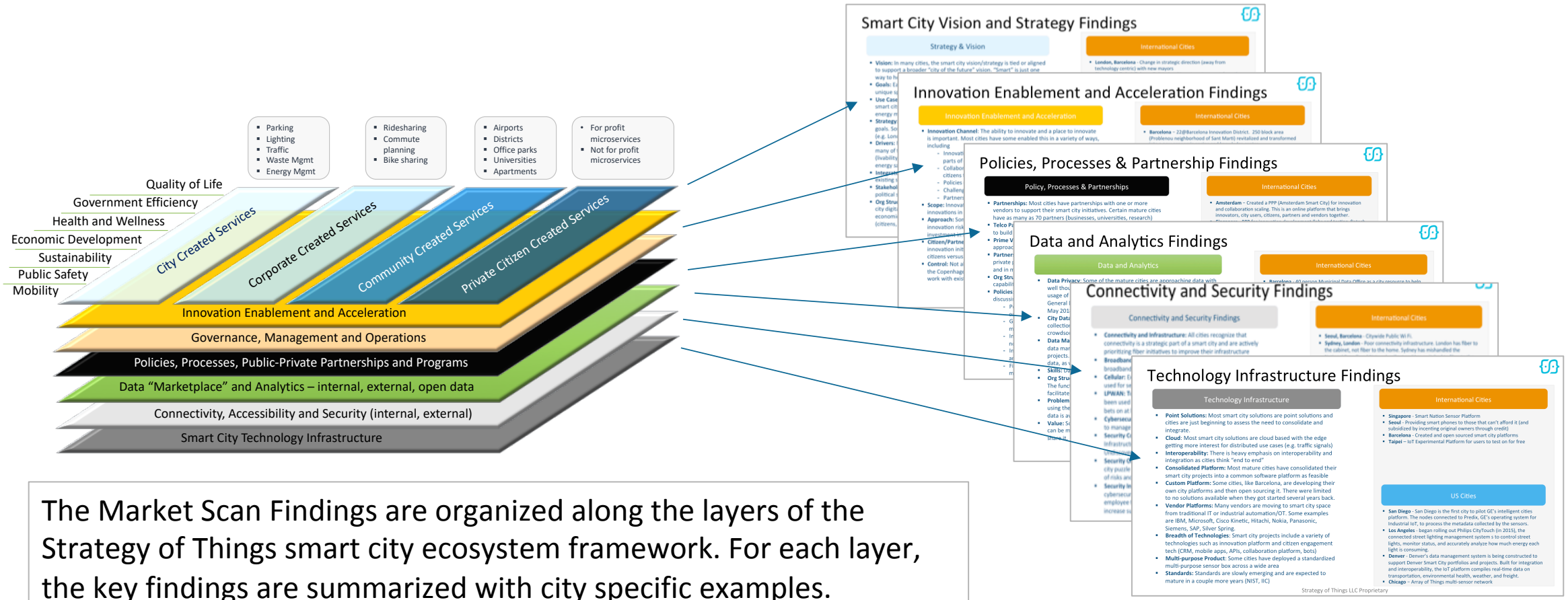
Smart City Global Trends Summary



- There is no one “standard” smart city model. Each city is unique, and have smart city initiatives that try to address their specific needs.
- Certain “smart city” solutions are common across multiple cities – lighting, parking, air quality, security. However, they are not the same, and many are implemented differently. For example, there are multiple variations of “smart” parking.
- The smart city continues to evolve. The first smart cities focused on technology and infrastructure. The newer cities incorporate technology but are more citizen centric.
- A dedicated program management office (aka innovation office, digital office, or transformation office), backed by clear vision/strategy and broad political support allowed cities like Dubai and Singapore to really “move the needle”.
- Most cities are using a living lab model for experimenting or introducing smart city solutions before scaling them out.
- Public private partnerships are a common vehicle used by almost all cities to fund initiatives, scale and augment city capabilities.
- Most cities are not addressing or building a cyber-secure smart city. Cyber- security initiatives are not designed in, nor understood or properly funded.
- Most cities recognize the strategic importance of data. While all cities have an open data portal, some cities are building data marketplaces for “city data” – a combination of open data and privately sourced data (businesses, citizens).

Structure of Market Scan Findings

Smart City Ecosystem Framework → Findings By Area → City Examples



The Market Scan Findings are organized along the layers of the Strategy of Things smart city ecosystem framework. For each layer, the key findings are summarized with city specific examples.

Smart City Vision and Strategy Findings

Strategy & Vision

- **Vision:** In many cities, the smart city vision/strategy is tied or aligned to support a broader "city of the future" vision. "Smart" is just one way to help the city realize this vision.
- **Goals:** Each city pursued their smart city initiatives based on their unique specific goals or situation
- **Use Cases:** Every city is pursuing some variation of the common smart city use cases (e.g. smart lighting, parking, air quality, traffic, energy management etc.) though it may be implemented differently.
- **Strategy:** Most cities have multi-year roadmaps aligned to major city goals. Some cities have shifted their overall strategy after few years (e.g. London, Barcelona)
- **Drivers:** Not all smart city projects were driven by technology with many of the "newer" smart cities starting with "citizen-centric" goals (livability, quality of life, experience), or "sustainability" goals (green, energy savings, etc.)
- **Integrated Programs**: Many cities re-purposed or re-grouped their existing silo-ed projects under a smart city initiative (e.g. Dubai)
- **Stakeholders:** Mature cities had broad multi department and political support for their smart city initiatives
- **Org Structure:** Multiple models of smart city leadership – led by a city digital office (formal or informal), by a single department (IT, economic development, DPW, etc.), or by a panel or commission (citizens, business, city). Some are offering a combination.

International Cities

- **London, Barcelona** - Change in strategic direction (away from technology centric) with new mayors
- **Singapore, Dubai, Tokyo** – Political and investment support from the highest levels (Prime Minister, Minister) of government
- **Barcelona, London, Amsterdam, Seoul, Tokyo, Taipei, Singapore** - Alignment with a broader multi-year city vision and master plan
- **Copenhagen** – Smart city strategy driven by vision of quality of life and goal in a green (carbon neutral by 2025) city. Technology and initiatives aligned around this goal.

US Cities

- **San Jose** - has developed a comprehensive smart city vision document for their smart city initiative
- **Washington DC** - Smarter DC is an interagency group comprised of dozens of city departments including the Office of the CTO (OCTO), District Department of Transportation (DDOT), the Department of Energy & Environment (DOEE) and DC Water.
- **Denver** - started its smart city journey in 2015 and got accelerated by the U.S. Department of Transportation's Smart City Challenge.

Innovation Enablement and Acceleration Findings

Innovation Enablement and Acceleration

- **Innovation Channel**: The ability to innovate and a place to innovate is important. Most cities have some enabled this in a variety of ways, including
  - Innovation streets, zones, districts, or even entire cities (or parts of cities)
  - Collaboration platforms – allows various cities, partners, citizens to come together (online, in person, etc.)
  - Policies (e.g. regulatory sandboxes)
  - Challenges around select problem areas
  - Partnerships with universities, labs, etc.
- **Scope:** Innovation is not limited to technology. There may be innovations in business models, policies, processes, etc.
- **Approach:** Some cities have taken various approaches to minimizing innovation risk. (e.g. large number of pilots, regulatory sand boxes, investment in innovation infrastructure)
- **Citizen/Partner Engagement**: In some of the mature cities innovation initiatives are now being led by partner organizations and citizens versus being led by the city alone
- **Control:** Not all innovation needs to be centralized. In Copenhagen, the Copenhagen Solutions Lab model is not to break silos, but to work with existing city departments to help them innovate solutions.

International Cities

- **Barcelona** – 22@Barcelona Innovation District. 250 block area (Problenou neighborhood of Sant Marti) revitalized and transformed into a new economic engine and knowledge center.
- **Amsterdam** - Evolving from city led to partner and citizen led projects
- **Singapore** – Create a regulatory sandbox for fintech innovation.
- **Copenhagen** - Innovation within department silos, facilitated by a central innovation office.
- **London, Barcelona, Amsterdam, Seoul, Tokyo** - Dedicated innovation or transformation offices.
- **Taipei** – innovation is focused on “matchmaking Users and Buyers” and facilitating innovation, rather than leading and delivering.

US Cities

- **LA** - The LA smart city experiment began at the University of Southern California and expands to the city of Los Angeles
- **NYC** - Brownsville, in Brooklyn, was first to have its own Neighborhood Innovation Lab
- **Dallas** - DIA is focusing on a 'living lab’ (two block area), which is a corridor located in the West End Historic District in Downtown Dallas.
- **Boston** - Seaport Innovation District became the first official US city among 80 innovation districts globally
- **Las Vegas** – Innovation District (downtown Las Vegas) with a specific focus on traffic, transportation and mobility.

Policies, Processes & Partnership Findings

Policy, Processes & Partnerships

- **Partnerships:** Most cities have partnerships with one or more vendors to support their smart city initiatives. Certain mature cities have as many as 70 partners (businesses, universities, research)
- **Telco Partners**: Telcos have vested interest in partnering with cities to build out their infrastructure for future commercial purposes
- **Prime Vendor:** Some cities have taken a single prime vendor approach to drive smart city initiatives (e.g. Denver)
- **Partnership Model:** Most cities have used some variation of public private partnership (PPP) model. PPP is not always about financing and in many cases a model to support scaling services
- **Org Structure:** Some cities have setup a dedicated office and/or capability to facilitate and manage partnerships
- **Policies:** There are several areas that cities have just started or are discussing developing policies on. Some of these are:
  - People and Organization: Citizen Engagement, City to external organization collaboration
  - Governance: Multi-agency and multi-city decision making, PPP models and guidelines
  - Innovation & Technology: Procuring solution from start-ups, non-traditional solutions, shared connectivity & platforms)
  - Information & Data (public/private data collection, IP rights and ownership from city innovations)
  - Financing & Revenue (financing models, revenue share models)

International Cities

- **Amsterdam** – Created a PPP (Amsterdam Smart City) for innovation and collaboration scaling. This is an online platform that brings innovators, city users, citizens, partners and vendors together.
- **Singapore** - PPP for innovation development (labs and testing, fintech, autonomous vehicles)
- **Dubai** – Dubai Smart City Accelerator is a PPP between the Smart Dubai Office, Emirates Integrated Telecommunications Company (du), Smart Dubai Office, the Dubai Chamber of Commerce, Rochester Institute of Technology, Orange Business Services and Visa.
- **Taipei** - PPP between UnaBiz (SigFox), Avnet and city government to develop, launch and manage the IoT Experimental Platform

US Cities

- **Dallas** - (DIA), a coalition of stakeholders (PPP non profit model) from the City of Dallas, corporations, Civic and NGO organizations, academia and private individuals. DIA has 30 partner organizations and 20 city department partners
- **Denver** - Panasonic's public-private partnership with Denver is catalyzing the creation of technology solutions that neither industry nor government can complete on their own.
- **Boston** - Boston has partnered with Verizon and developed a Smart City Playbook for technology companies, scientists, researchers, journalists, and activists

Data and Analytics Findings

Data and Analytics

- **Data Privacy**: Some of the mature cities are approaching data with well thought out policies that protect the privacy and govern the usage of data. European cities are leading in this area because the General Data Protection Regulation (GDPR) comes into effect in May 2018.
- **City Data vs Open Data**: Some of the mature cities are embracing collection and usage of city data that includes open data, crowdsourced data and data from private sources.
- **Data Marketplace**: Some of the mature cities are also building out data marketplace to facilitate creating value from various smart projects. These data marketplaces involve city generated open data, as well as citizen and business provided data.
- **Skills:** Data analysis skills is a necessary skill to have for smart cities
- **Org Structure**: Some cities have created a city data analytics office. The function of these offices are to provide assistance and to facilitate the usage/interpretation of the data.
- **Problem Solving:** Some cities set up specific problems to solve using the data available to them. They don't just assume that if the data is available, people will look for it on their own.
- **Value:** Some cities are trying to put a value around data so that it can be monetized, and more importantly, to incentivize people to share it.

International Cities

- **Barcelona** - 40 person Municipal Data Office as a city resource to help city agencies interpret and make use of data collected
- **Amsterdam, London, Copenhagen, Barcelona** - City data marketplaces and monetization programs
- **Singapore** - Data scientist recruitment.
- **Amsterdam, Barcelona** – Piloting DECODE technology that allows citizens to specify what data they want to share, who to share it with.

US Cities

- **NYC** - has developed guidelines on five areas to help smart city initiatives: Privacy and Transparency, Data Management, Infrastructure, Security and Operations/Sustainability.
- **Seattle** - is known for taking a leadership position in drafting data policies that other cities beginning to use as reference model
- **Boston** - Verizon owns data captured from cameras and is giving it to the City through a license agreement and will not use the data for commercial purposes unless it supports the pilot or Verizon's internal technology development work
- **Kansas City** - owns all data and will soon migrate it to the City's Open Data Catalog. A smart city data privacy policy was established (modelled after Seattle) in 2015

Connectivity and Security Findings

Connectivity and Security Findings

- **Connectivity and Infrastructure:** All cities recognize that connectivity is a strategic part of a smart city and are actively prioritizing fiber initiatives to improve their infrastructure
- **Broadband:** Mature cities have robust and well connected broadband access (e.g. fiber) and strong wi-fi connectivity
- **Cellular:** Existing cellular network (2G/3G/LTE) continues to be used for several smart city use cases
- **LPWAN: T**echnologies such as Sigfox, LoRaWAN and NB-IoT has been used to support smart city projects. Most cities are placing bets on at least one LPWAN technology (unlicensed and licensed)
- **Cybersecurity Management**: Most (91%) smart cities are not ready to manage smart city cybersecurity (source)
- **Security Concerns:** Top 5 concerns in cyber security are Critical Infrastructure, Citizen Data, Major Breach, Ransomware, Undiscovered vulnerability (source)
- **Security Obstacles**: Cybersecurity is a missing piece of the smart city puzzle with most citing reasons as budget, politics, awareness of risks and not knowing what to do
- **Security Initiatives:** Key things cities are doing include Unified cybersecurity center (Dubai, Singapore, Los Angeles), charging $62/ employee to fund security operations (San Diego) and training to increase supply of security pros (London, Chicago)

International Cities

- **Seoul, Barcelona** - Citywide Public Wi Fi.
- **Sydney, London** - Poor connectivity infrastructure. London has fiber to the cabinet, not fiber to the home. Sydney has mishandled the National Broadband Network rollout and has switched to fiber to the cabinet, not the home. As such, most connections today are still copper.
- **Seoul** - Multi-connectivity strategy (fiber, wi-fi, LoRaWAN, NB-IoT)
- **Taipei** - Incorporating blockchain technology as an integral part of its smart city to secure its infrastructure.
- **Dubai, Singapore** - Dedicated cyber-security centers.

US Cities

- **NYC** - LinkNYC stands as one the largest investments in public broadband infrastructure and is being replicated by cities like London
- **Chicago** - Current initiatives are primarily connected through AT&T cellular network
- **Dallas** - Fiber and cellular networks are providing coverage and powering the living lab.
- **Boston** - Magnetometers and micro radar devices use Zigbee to communicate to nearby traffic cabinets (cellular backhaul)
- **San Diego** - Smart Street Light network powered by GE will have capability to offer 5G services from AT&T in the future
- **Chula Vista** - The smart city master plan includes input on how to build out the city using high-speed fiber internet service

Technology Infrastructure Findings

Technology Infrastructure

- **Point Solutions:** Most smart city solutions are point solutions and cities are just beginning to assess the need to consolidate and integrate.
- **Cloud**: Most smart city solutions are cloud based with the edge getting more interest for distributed use cases (e.g. traffic signals)
- **Interoperability:** There is heavy emphasis on interoperability and integration as cities think “end to end”
- **Consolidated Platform:** Most mature cities have consolidated their smart city projects into a common software platform as feasible
- **Custom Platform:** Some cities, like Barcelona, are developing their own city platforms and then open sourcing it. There were limited to no solutions available when they got started several years back.
- **Vendor Platforms:** Many vendors are moving to smart city space from traditional IT or industrial automation/OT. Some examples are IBM, Microsoft, Cisco Kinetic, Hitachi, Nokia, Panasonic, Siemens, SAP, Silver Spring.
- **Breadth of Technologies**: Smart city projects include a variety of technologies such as innovation platform and citizen engagement tech (CRM, mobile apps, APIs, collaboration platform, bots)
- **Multi-purpose Product**: Some cities have deployed a standardized multi-purpose sensor box across a wide area
- **Standards:** Standards are slowly emerging and are expected to mature in a couple more years (NIST, IIC)

International Cities

- **Singapore** - Smart Nation Sensor Platform
- **Seoul** - Providing smart phones to those that can’t afford it (and subsidized by incenting original owners through credit)
- **Barcelona** - Created and open sourced smart city platforms
- **Taipei** – IoT Experimental Platform for users to test on for free

US Cities

- **San Diego** - San Diego is the first city to pilot GE’s intelligent cities platform. The nodes connected to Predix, GE’s operating system for Industrial IoT, to process the metadata collected by the sensors.
- **Los Angeles** - began rolling out Philips CityTouch (in 2015), the connected street lighting management system s to control street lights, monitor status, and accurately analyze how much energy each light is consuming.
- **Denver** - Denver’s data management system is being constructed to support Denver Smart City portfolios and projects. Built for integration and interoperability, the IoT platform compiles real-time data on transportation, environmental health, weather, and freight.
- **Chicago** – Array of Things multi-sensor network

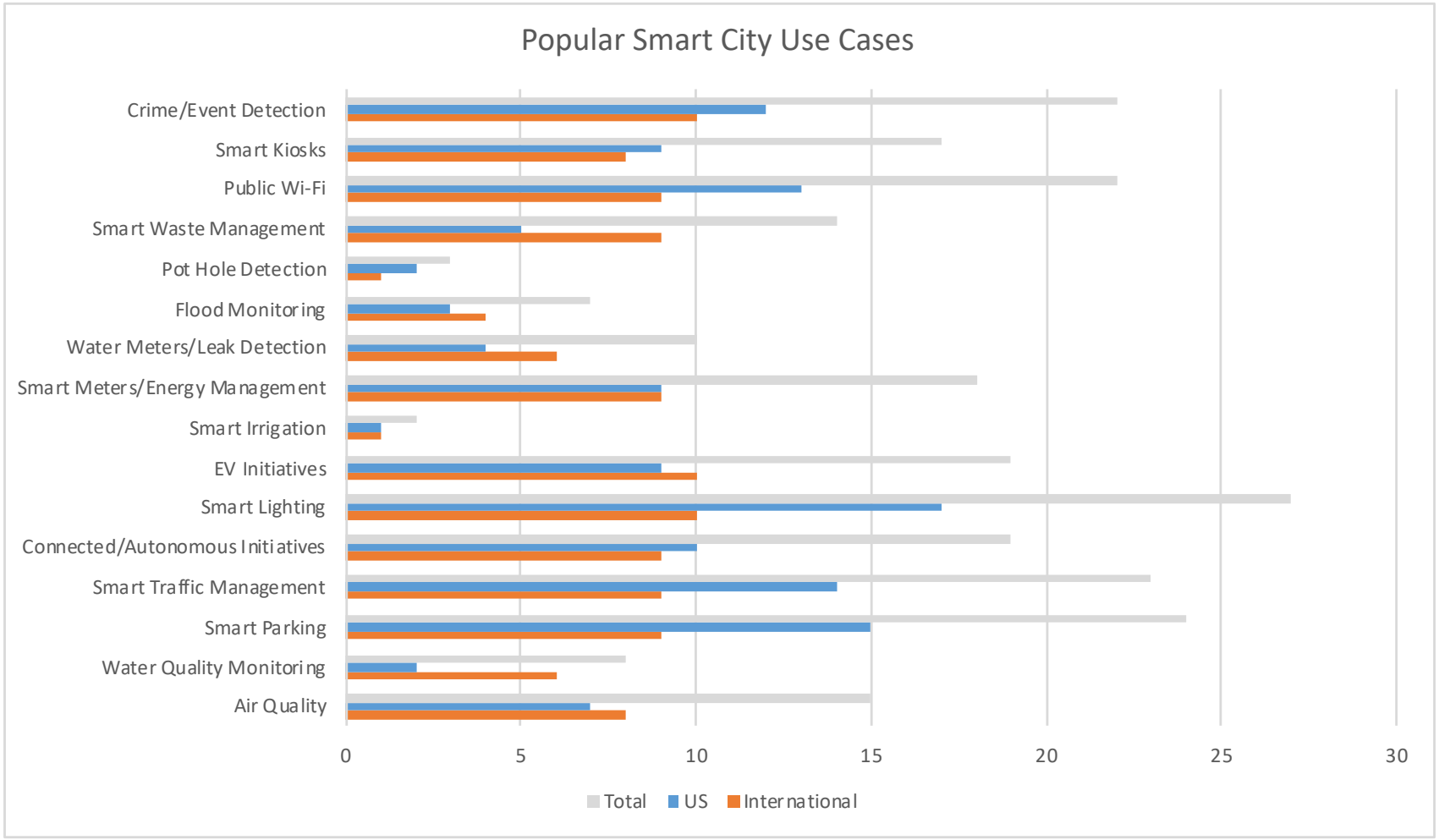
Use Case Landscape – Popular Use Cases By City

	> 3 Mill		1 - 3 Mill			500K - 1 Mill									Less than 500K					> 5 Mil					1.5 - 3 Mill			< 1 Mill	
	New York	Los Angeles	Chicago	Dallas	San Diego	San Jose	San Francisco	Columbus	Las Vegas	Seattle	Denver	Washington DC	Boston	Portland	Kansas City	Atlanta	Sacramento	Chula Vista		Tokyo	Seoul	London	Singapore	Sydney	Dubai	Taipei	Barcelona	Amsterdam	Coppenhagen
Health & Wellness																													
Air Quality			x	x		x			x		x	x		x							x	x	x		x	x	x	x	x
Water Quality Monitoring				x								x									x		x			x	x	x	x
Mobility																													
Smart Parking	x	x		x	x	x	x	x	x		x	x	x	x		x	x	x			x	x	x	x	x	x	x	x	x
Smart Traffic Management		x	x	x		x	x	x	x	x	x	x	x	x		x	x			x	x		x	x	x	x	x	x	x	x
Connected/Autonomous Initiatives	x			x		x		x	x		x		x		x		x	x		x	x	x	x	x	x	x		x	x
Sustainability																													
Smart Lighting	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
EV Initiatives			x		x		x	x	x		x			x		x		x		x	x	x	x	x	x	x	x	x	x
Smart Irrigation				x																							x			
Smart Meters/Energy Management			x	x	x		x		x		x			x		x	x			x	x	x	x		x	x	x	x	x
Government Efficiency																													
Water Meters/Leak Detection							x		x		x	x								x		x	x		x	x	x		
Flood Monitoring			x									x				x					x		x					x	x
Pot Hole Detection															x			x			x								
Smart Waste Management				x					x			x				x		x			x	x	x	x	x	x	x	x	x
Digital Access																													
Public Wi-Fi	x		x	x			x		x	x	x	x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	
Smart Kiosks	x		x	x	x				x				x		x		x	x		x	x	x	x	x	x		x	x	
Public Safety																													
Crime/Event Detection	x		x	x	x	x	x		x		x	x	x		x		x			x	x	x	x	x	x	x	x	x	x

Use Case Landscape – Unique Use Cases By City

	> 3 Mill		1 - 3 Mill			500K - 1 Mill									Less than 500K					More than 5 Mil					1.5 - 3 Mill			< 1 Mill	
	New York	Los Angeles	Chicago	Dallas	San Diego	San Jose	San Francisco	Columbus	Las Vegas	Seattle	Denver	Washington DC	Boston	Portland	Kansas City	Atlanta	Sacramento	Chula Vista		Tokyo	Seoul	London	Singapore	Sydney	Dubai	Taipei	Barcelona	Amsterdam	Coppenhagen
Health and Wellness																													
Smart health monitoring																							x		x				
Mobility																													
Smart signage for truck parking and loading/unloading																												x	
Keypass passenger tracking																												x	
Bike sharing										x			x																
Digital payaments																						x	x						
Sustainability																													
Vehicle2Grid (EV as temporary batt)																												x	
Geen building requirement																				x									
Journey Insight																													x
Government efficiency																													
Smart citizen kit																												x	
Digital platform for citizen participation		x														x											x	x	
City building toilet QR codes																										x			
Alexa voice info system									x																				
Quality of Life																													
Leave Your Luggage service to airport																												x	
Superblocks																											x		
Smart street furniture/bus shelters																								x					
Public Safety																													
Decode (data privacy)																											x	x	
Smart lamp posts																									x				
MyResponder volunteer first responder																							x						
UAV comm platform for disasters																										x			
Structure monitoring														x															
Economic Development																													
GovBuy																							x						
Civic Innovation Hub	x																						x			x	x	x	

Use Case Analysis: Top 5 Use Cases



Top 5 Overall Use cases

- Smart Lighting
- Smart Parking
- Smart Traffic Management
- Public Wi-Fi
- Crime/Event Detection

Top 5 US City Use cases

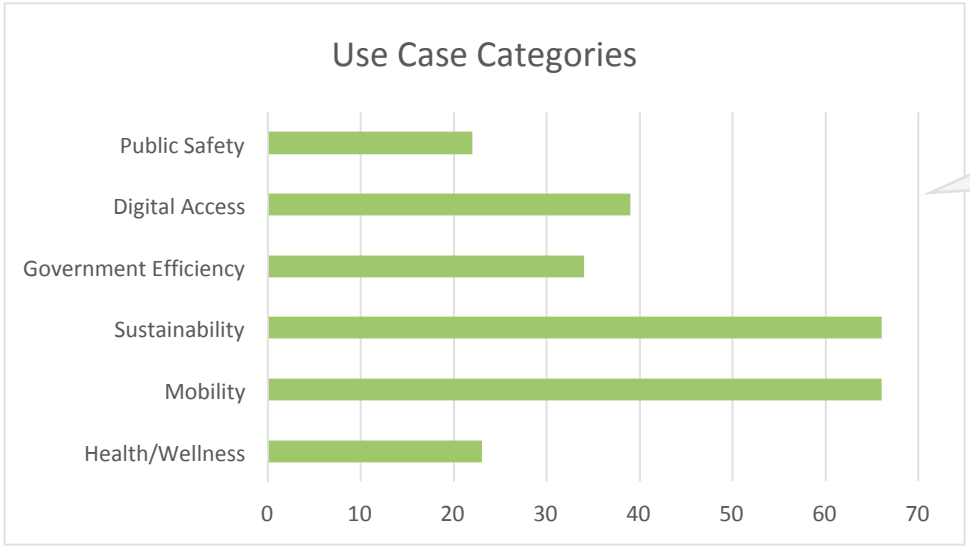
- Smart Lighting
- Smart Parking
- Smart Traffic Management
- Public Wi-Fi
- Crime/Event Detection

Top 5 International City Use cases

- Smart Lighting
- EV Initiatives
- Crime/Event Detection
- Smart Traffic Management*
- Smart Parking*
- Public Wi-Fi*
- Waste Management*
- Connected Autonomous Initiatives*

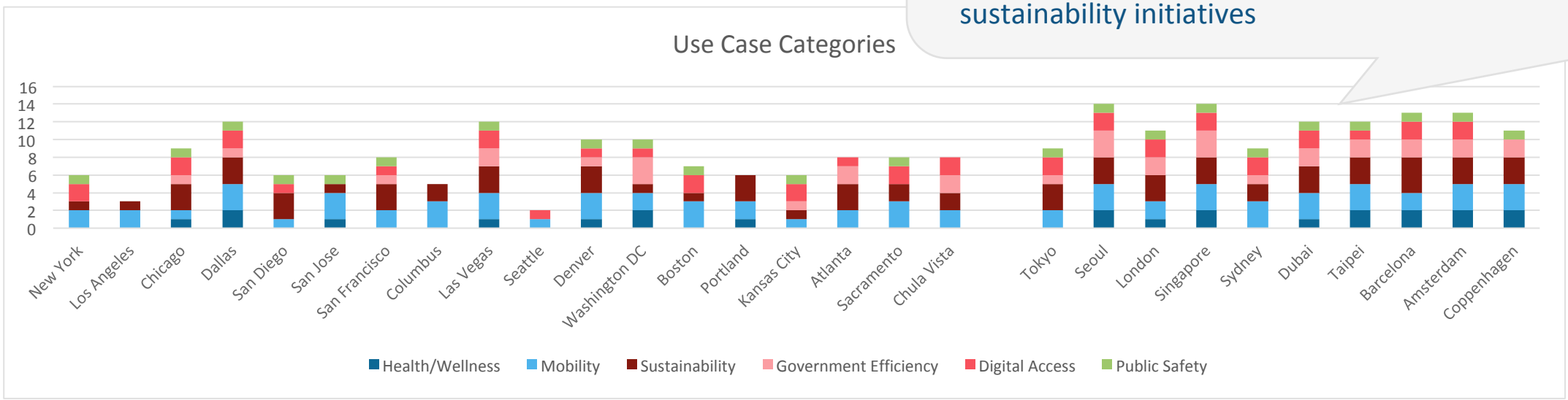
** - Tie between use cases*
Sample Size: Total 28 Cities, 18 US Cities and 10 International Cities

Use Case Analysis: Top Use Case Categories



- Mobility (smart parking, smart traffic and connected/AV initiatives) and Sustainability (smart lighting, EV, smart meters) were the two most popular use case categories among 28 cities reviewed

- Most cities have more than 8 use cases, across a variety of use case categories, as part of their smart city initiatives.
- Almost all cities had some kind of mobility and sustainability initiatives



Sample Size: Total 28 Cities, 18 US Cities and 10 International Cities

Strategic Recommendations

Best Practices

Strategy and Vision	1	Build your smart city strategy and plan, based on your unique set of capabilities, resident, city and agency needs, and context.
	2	Establish broad support across the entire city political and management ecosystem.
	3	Establish a sustainable citizen, business, and agency outreach, engagement and collaboration process. Integrate these stakeholders into the innovation ecosystem.
Innovation Enablement & Acceleration	4	Establish an innovation office and innovation capability (e.g. innovation lab, processes, SMEs partners), not only at the city or county level, but with representation at the city and county agency level.
	5	Drive innovation success. Create one ore more innovation zones, along with a structure that ensures relevance and impact. This may include bringing in the right problem sets, the right partners, and a process for creating and testing solutions.
Policy, Processes & Partnerships	6	Develop and master partnership competence starting from strategy, identification/sourcing, negotiation, consummation, and management/operation of partnerships. Some of these are non-traditional partnerships involving working with vendors in new ways, with new partners like non-profits, venture capital/financing companies, different county agencies and other cities.
	7	Develop multiple traditional and non-traditional funding channels and financing competence

Best Practices

Data & Analytics

8. Develop a county/city data strategy and competence. This involves the following – a data strategy, a data infrastructure, data partnerships, data analytics tools, and data analysis capabilities

9. Develop a privacy policy and plan for data collection, storage, usage and sharing. Integrate into the solution (technology, services) design, procurement and operations processes. Integrate with the SMC smart city cybersecurity plan.

10. Develop innovation analysts with data analysis and specific county/city domain expertise. For example, a person who specializes in mobility, and understands not only how to analyze data, but to correlate it with other data to "connect the dots", and understand what it means.

11. Develop a data marketplace where county, city, business and citizen data can be searched, monetized and shared. This doesn't have to be done immediately, but the foundational and planning should account for this capability.

Connectivity & Security

12. Integrate existing fiber and public wi-fi strategy with a multi-LPWAN connectivity strategy.

13. Build confidence and trust in a smart city/county from the start. Build in a smart city cybersecurity plan from the beginning, and make that an integral part of your overall infrastructure, operations, and management plan.

Best Practices

Technology Infrastructure	14	Modernize the technology infrastructure. Many existing systems are not set up to handle citizen interactions (payments, electronic records, etc.), lack robust security and integration, does not support new data types or expected service levels.
	15	Develop an interaction layer that integrates the various smart city point solutions. This includes user defined visualization and control panels, accessible via user specified mediums (browser, mobile, VR/AR, etc.).
	16	Develop a future proofing strategy for your technology infrastructure in an early market where standards are emerging and the vendor ecosystem is still immature..

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