SMART CITIES
Report Date: 1/19//2018

Definition

A **smart city** is an urban area that uses different types of electronic data collection sensors to supply information that is used to manage assets and resources efficiently. This includes data collected from citizens, devices, and assets that is processed and analyzed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management, law enforcement, information systems, schools, libraries, hospitals, and other community services. The smart city concept integrates information and communication technology (ICT), and various physical devices connected to the network (the Internet of Things or IoT) to optimize the efficiency of city operations and services and connect to citizens. Smart city technology allows city officials to interact directly with both community and city infrastructure and to monitor what is happening in the city and how the city is evolving.

Information and communication technology (ICT) is used to enhance quality, performance and interactivity of urban services, to reduce costs and resource consumption and to increase contact between citizens and government. Smart city applications are developed to manage urban flows and allow for real-time responses. A smart city may therefore be more prepared to respond to challenges than one with a simple "transactional" relationship with its citizens. Yet, the term itself remains unclear to its specifics and therefore, open to many interpretations.

Other terms that have been used for similar concepts include *cyberville*, *digital city*, *electronic communities*, *flexicity*, *information city*, *intelligent city*, *knowledge-based city*, *MESH city*, *telecity*, *teletopia*, *Ubiquitous city*, *wired city*.

Major technological, economic and environmental changes have generated interest in smart cities, including climate change, economic restructuring, the move to online retail and entertainment, ageing populations, urban population growth and pressures on finances. The European Union (EU) has devoted constant efforts to devising a strategy for achieving 'smart' urban growth for its metropolitan city-regions. The EU has developed a range of programmes under 'Europe's Digital Agenda". In 2010, it highlighted its focus on strengthening innovation and investment in ICT services for the purpose of improving public services and quality of life. Arup estimates that the global market for smart urban services will be $400 billion per annum by 2020. Examples of Smart City technologies and programs have been implemented in Dubai, Milton Keynes, Southampton, Amsterdam, Barcelona, Madrid, Stockholm, China and New York.[1]

[1] Wikipedia

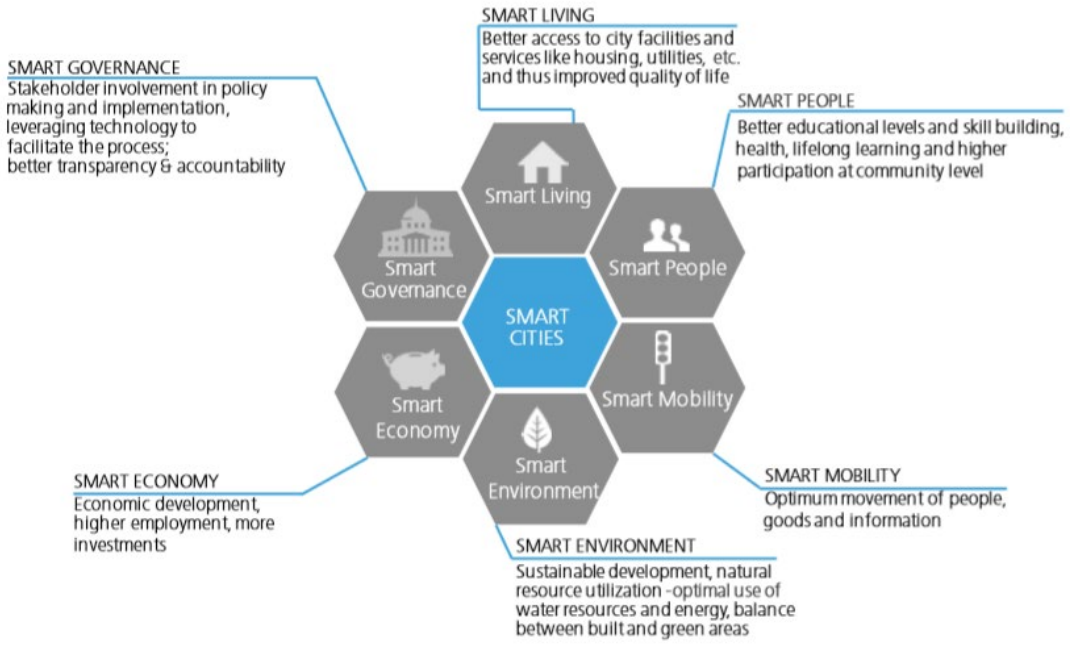
A “smart city” is an urban area that uses technology to provide high-tech services as well as more efficient services to the neighborhood.

Practical Areas / Implementation

With half the world’s population living in cities, increasing the strain on energy, transportation, water, building and public spaces, there is an increasing need for “smart” city solutions which are both efficient and sustainable on one hand and can generate economic prosperity and social wellbeing on the other.[2] From Oslo to San Diego, cities across the globe are installing technology to gather data in the hopes of saving money, becoming cleaner, reducing traffic, and improving urban life.[3]

“Turning into a smart city is about bringing together the ideas of the people living there, the ideas of the builders and makers, the ideas of the academic field, and investors that can add value.

In a smart city, technology and innovation are key drivers of growth in the economy. Hence, all stakeholders – institutions of higher learning, multinational corporations, government agencies, research institutes, etc. – work together in a coordinated manner to identify and address the needs of an urban economy.[4]



Components of Smart Cities Chart[5]

[2] 100 Smart cities in India Facilitating implementation, Deloitte, February, 2015.
[3] Tech is Making Life in Barcelona Better, Even If You Don’t Know It’s There, Digital Trends, July 24, 2017.
[4] Implementing the Smart City, The Straits Times.
[5] Ibid 2.

Sample Implementations to Create Smart Cities:

1. Wi-fi hotspots
2. Traffic monitoring systems
3. Bus/subway arrival notifications
4. Street lights that dim when nobody is nearby
5. Escalators that operate only when people step on them
6. Smart parking services (systems that inform people of available parking spaces)
7. Self-service MyHealth Kiosks
8. Resident tracking of their electricity, gas and water usage
9. Monitoring systems for elderly resident safety
10. Incident management (includes prevention) and collaborative response
11. Public rental bikes / bike racks
12. Waste bins with sensors so that garbage can be emptied accordingly
13. Pothole detection

Key Players in the U.S. and World

According to a report by Frost & Sullivan, smart cities are anticipated to create huge business opportunities across different industries with a total market value of $1.565 trillion by 2020. Technologies such as smart metering, wireless sensor networks, open platforms, high-speed broadband and cloud computing are key building blocks of the smart city infrastructure. Research shows that two companies are top vendors in the "smart city" tech market with IBM and Cisco in podium positions. Which other companies supply the technology enabling smart cities to rise?

The ten companies below are the ones that already have a firm establishment in this evolving market, and will continue to increase their activities to get a large piece of the pie.[6]

Smart cities are built by these top ten companies (More details on specific smart city projects are on page 13):

Cisco
Schneider Electric
Siemens
Microsoft
Hitachi
Huawei
Ericsson
Toshiba
Oracle

[6] These Are the Top Ten Companies that Build Smart Cities, Smart City Hub, April 4, 2017.

.**Start-Ups (Companies Building Smarter Cities)**

Company	Select Investors	Category
ParkWhiz	Jump Capital, Amicus Capital, Hyde Park Venture Partners	Parking
Parkifi	Crosslink Capital, Foundry Group, Drummond Road Capital	Parking
SpotHero	500 Startups, Battery Ventures, Lightbank	Parking
ETCP	Wanda Group	Parking
Spot	Undisclosed Investors	Parking
Evopark	Porsche Automobile Holding	Parking
Get My Parking	Chennai Angels	Parking
EZParking	ZJAMP Holding Group	Parking
AppyParking	Aviva Ventures	Parking
CivicSmart	N/A	Parking
Passport	MK Capital, Relevance Capital, Grotech Ventures	Parking
MeterFeeder	Y Combinator	Parking
Telensa	Silicon Valley Bank, Environmental Technologies Fund	Grid/Energy
Gridcure	500 Accelerator	Grid/Energy
Utilidata	Formation 8, Braemar Energy Ventures, American Electric Power	Grid/Energy
Space-Time Insight	EnerTech Capital, Novus Energy Partners, Opus Capital	Grid/Energy
AutoGrid Systems	E.ON, Foundation Capital, Voyager Capital	Grid/Energy

.Start-Ups (Companies Building Smarter Cities)

Company	Select Investors	Category
Varentec	3M New Ventures, Khosla Ventures, Bill Gates	Grid/Energy
Dispatchr	Floodgate, Backed VC	Grid/Energy
Energyworx	HenQ, SET Venture Partners	Grid/Energy
Trilliant	Selby Venture Partners, Zouk Capital, VantagePoint Capital Partners	Grid/Energy
Opus One Solutions	Engle New Ventures, Energy Impact Partners	Grid/Energy
Mapillary	Atomico, Sequoia Capital, LDV Capital, Playfair Capital	Urban Planning
Civic Insight	N/A	Urban Planning
Calthorpe Analytics	Undisclosed investors	Urban Planning
Neighborland	SV Angel, True Ventures, Lerer Hippeau Ventures	Urban Planning
Azavea	Dogpatch Labs	Urban Planning
Social Bicycles	SOSventures. New York Angels, SoundBoard Angel Fund	Smarter Transport
Zagster	Fontinalis Partners, LaunchCapital, Investors Circle	Smarter Transport
Mobike	Panda Capital, Sequoia Capital China, Tencent, Warbung Pincus, Hillhouse Capital	Smarter Transport
Ofo	Coatue Management, CITIC Capital, Matrix Partners China, GSR Ventures, Xiaomi	Smarter Transport
Shuttl	Sequoia Capital India, Lightspeed Venture Partners, Times Internet	Smarter Transport

.**Start-Ups (Companies Building Smarter Cities)**

Company	Select Investors	Category
ZipGo	Orios Venture Partners	Smarter Transport
Urbee	Amsterdam Klimaat & Energiefonds	Smarter Transport
Ubike	Yicun Capital, Black Hole Capital, Zhonglu Capital	Smarter Transport
Cityflo	IDG Ventures India	Smarter Transport
Bridj	NextView Ventures, Atlas Ventures, Suffolk Equity Partners	Smarter Transport
Plume Labs	Undisclosed investors	Environmental Sensors
Breezometer	Launchpad Digital Health, JumpSpeed Ventures	Environmental Sensors
Ambience Data	500 Accelerator	Environmental Sensors
Clarity Movement	Undisclosed investors	Environmental Sensors
eLichens	Aereco, BPI France, Angels' Bay Invest, Paris Business Angels, Grenoble Angels, Sofimac Partners, Business Angels des Grandes Ecoles	Environmental Sensors
Understory	RRE Ventures, True Ventures, SK Ventures	Environmental Sensors
Blyncsy	Pelion Venture Partners, Peterson Ventures, Subtraction Capital	Environmental Sensors
Aclima	N/A	Environmental Sensors

.Start-Ups (Companies Building Smarter Cities)

Company	Select Investors	Category
Veniam	Union Square Ventures, True Ventures, Verizon Ventures	Connectivity
Purple WiFi	Juno Capital, Bill Currie, Bob Willett, Terry Leahy	Connectivity
SigFox	Elaia Partners, iXO Private Equity, Intel Capital, Partech Ventures, BPI France	Connectivity
Qianhai Mobile	Baidu, Dongguan Zhongke Zhongguang Venture, Guangdong Zhongke Baiyun New Industry Venture	Connectivity
Filament	Resonant Venture Partners, Samsung Ventures, Bullpen Capital	Connectivity
Remix	Y Combinator	Traffic/Transit
Streetlight Data	Osage University Partners, Vision Ridge Partners, Deutsche Telekom Strategic Investments	Traffic/Transit
Transloc	Fontinalis Partners, SJF Ventures, Patient Capital Collaborative, Marc Benioff, Thomas McMurray	Traffic/Transit
Transit Labs	N/A	Traffic/Transit
Trafi	BaltCap, Practica Capital, Octopus Ventures, EBRD	Traffic/Transit
Transloc	Fontinalis Partners, SJF Ventures, Patient Capital Collaborative, Marc Benioff, Thomas McMurray	Traffic/Transit
Swiftly	Plug and Play Accelerator	Traffic/Transit
Ally	ERP-Startfonds	Traffic/Transit
WhereIsMyTransport	Horizen Ventures, Goodwell Investments, Omidyar Network, Infotech Ventures	Traffic/Transit

.Start-Ups (Companies Building Smarter Cities)

Company	Select Investors	Category
Ridlr	Matrix Partners India, Qualcomm Ventures, InnoVen Capital, Times Internet	Traffic/Transit
Inrix	August Capital, Bain Capital Ventures, Intel Capital	Traffic/Transit
TransitScreen	1776	Traffic/Transit
Citymapper	Balderton Capital, Index Ventures, Greylock Partners, Benchmark	Traffic/Transit
Miovision	Plaza Venture Partners, Renewal Funds, Investeco Capital	Traffic/Transit
Metrotech	Undisclosed Investors	Traffic/Transit
Transit App	Real Ventures, Accel, Accomplice, BDC Capital, FounderFuel	Traffic/Transit
DoubleMap	N/A	Traffic/Transit
Moovit	BMW iVentures, Sequoia Capital Israel, Nokia Growth Partners	Traffic/Transit
Ayyeka	ImagineH20	Water Usage/Quality
Flow Labs	Orange Fab	Water Usage/Quality
FATHOM	Silver Lake, XPV Capital	Water Usage/Quality
Pluto AI	Imagine H2O, 500 Accelerator	Water Usage/Quality
Emagin	Imagine H2O	Water Usage/Quality
Banyan Water	Cue Ball Capital, Catamount Ventures, Centennial Ventures, Owl Ventures	Water Usage/Quality

.Start-Ups (Companies Building Smarter Cities)

Company	Select Investors	Category
Rachio	Slow Ventures, Foundry Group, SK Ventures	Water Usage/Quality
Valor Water Analytics	Y Combinator, ImagineH20, 500 Startups, Apsara Capital, Urban Innovation Fund, Syzygy West	Water Usage/Quality
WaterSmart Software	Draper Fisher Jurvetson, Physic Ventures, Westly Group	Water Usage/Quality
One Concern	Pear	Disaster Management
Zenysis	Y Combinator	Disaster Management
Rubicon Global	Wellington Management, Goldman Sachs, Nima Capital, Suez Ventures, Henry Kravis, Paul Tudor Jones II, Blake Mycoskie	Waste Management
Compology	Sinovation Ventures, Fresco Capital, Kapor Capital, LaunchCapital, Silicon Badia	Waste Management
Enevo	Lifeline Ventures, Finnish Industry Investment, Draper Associates, Earlybird Venture Capital, Foxconn Technology Company, Ginko Ventures	Waste Management
ZeroCycle	N/A	Waste Management
AMCS Group	Insight Venture Partners, Ireland Strategic Investment Fund, Highland Europe	Waste Management[7]

[7] 80+ Startups Making Cities Smarter Across Traffic, Waste, Energy, Water Usage, And More, CB Insights, Jan. 24, 2017.

Top 10 City Startups North America 2017

Emerging Technologies / Market Trends / R&D

List of Top Technologies Every Smart City Should Have

Schneider Electric, Siemens, Microsoft, Hitachi, Huawei, Ericsson, Toshiba, Oracle and many other big companies work on smart city projects. In addition, these promising startups can revolutionize the way we live, making this world a better place to live.

Waste Management
Waste management is on the priority list in most cities. Bigbelly is a smart waste and recycling system that has been implemented in main cities of the US and in more than 50 countries around the globe. Bigbelly provides a solar-powered compacting waste bin that allows for up to five times the amount of waste as a traditional bin. What is also good about it and the most demanded feature is that it alerts the appropriate city department when it needs to be emptied. This means that the number of trash bins in a city can be reduced by 70-80%, which makes the streets more aesthetically appealing. Also, it reduces traffic jams and ensures that the cars take full rubbish bins instead of coming twice for half-full bins.

Another interesting company that also works on waste management is Zerocycle, which collects and analyzes garbage and recycling data to determine recycling rates for each neighborhood in a city. The company shares those insights in customized Neighborhood Waste Reports, which are sent to every household in the service area.

Security
ShotSpotter is a company that works on reducing the crime rate in cities. Gunfire is undoubtedly one of the most dangerous aspects of urban life. When a gunshot is heard, it's not always reported because people get scared or are not sure if this is a gunshot or something else. But sound sensors, whether standalone, from a company such as ShotSpotter, or added to a smart streetlight, can detect gunshots and automatically report it to a police department without depending on citizen involvement. The software can also determine how many shots were fired, and how many shooters are present, helping police officers who respond to the call.

Digital Kiosks
We live in a world where almost everything can be controlled by phone to avoid wasted time standing in a queue to get tourism information. We can just use our phones and Google it or find some info on Tripadvisor, Foursquare, etc. But sometimes, we have problems with the battery or we don't want to spend too much time on research or sometimes we just have unexpected trips which makes digital kiosks on the streets with information about the city are a good idea.

Digital kiosks give information about restaurants, retail stores, and events in the immediate area. It also provides mapping for visitors and can sync with a mobile phone

to give additional data as needed. For example, Citymapper pulls in public transport information and provides multi-modal transport options to get users to their chosen destinations. It really saves time and makes it easy for travelers to find information without reading many articles to get directions.

Smart Streetlights
LED streetlights have numerous benefits. One of the main benefits is reduced crime, because the lights automatically brighten when there are multiple people in the area, and dim when no one is around. ROI and savings are realized. With LED lights, just in few years, ROI is noticed in monthly savings on street lighting. For example, in Los Angeles, the city saves nearly $9 million annually on utility costs as a result of its decision to spend $57 million to convert nearly 80% of its 215,000 old sodium-vapor streetlights to LED versions. DOLL supports municipalities, regions, and private companies, in cooperation with scientists, with the development of new and improved lighting solutions.

Parking Sensors
If you live in a city, you probably experience parking problems. Now, a lot of companies work on solutions that simplify parking a car. These mobile apps can tell you when a parking spot is available, using parking sensors. European cities were early adopters of this technology. For example, in Paris, France, the average resident spends four years of their life looking for a parking spot, according to Cisco. With widespread use of parking sensors, traffic in Paris has dropped dramatically.

This technology really simplifies our lives by indicating the nearest available parking spot. It saves time, gas, emissions, and money while also easing the flow of traffic and overall satisfaction of living in a city where it is convenient to live. If we talk about companies that work on these solutions, the first company that comes to mind is ParkWhiz, which aims to help anyone find a parking spot from a web browser or mobile phone. Public and private parking garages list available spaces and pricing on ParkWhiz. This app also allows people to instantly reserve a spot with a credit card.

Open Data Initiatives
Every city should support open data initiatives and hackathons. In New York City, they organize BigApps competition, which produces useful and resource-saving apps to improve cities and keep citizens informed. Things like air quality, restaurant sanitation scores, building inspection scores and impending legislation should be readily available for all citizens.

Air Quality Sensor
Unfortunately, now living in a city has some side effects like for example problems with health, etc. Living in a city means having a lot of stress and rarely breath fresh air. TZOA uses internal sensors to measure your air quality, temperature, humidity, atmospheric pressure, ambient light, and UV – all in one wearable device. In other words, TZOA is a wearable enviro-tracker that helps you stay healthy and explore your environment. It takes data from your environment in real-time and turns it into actionable recommendations to keep you healthy. Having data and a smartphone app, you can know if you need to open a window in your home, take a bike and choose a different route to work, or get more or less sun. These recommendations help to change

behaviors and improve your quality of life.

Climate Monitoring
EverImpact discovers the origins of greenhouse gas emissions in your city. It is the climate monitoring app for cities, which measures and monetizes Cities' CO2 emission by combining Satellites and Ground Sensors' data. Cities get a real-time map of their emissions at street and building level which helps to control the environmental situation in the cities.

Social Impact
A success story of digital services developed from open data in Helsinki is the mobile GPS app BlindSquare that helps the blind and visually impaired people navigate through the city by describing the environment, announcing points of interest and street intersections to users, and telling them where to go.[8]

Market Trends

IoT technology revenues across 12 key smart city technologies and verticals will grow from around US$25 billion in 2017 to US$62 billion in 2026 at an average growth rate of 11%. According to ABI Research, a market-foresight advisory firm providing strategic guidance on the most compelling transformative technologies, while smart meters and video surveillance represent the largest absolute revenue opportunities, the fastest growing verticals include EV charging stations and micro-grids, smart waste management and environmental sensors, smart parking, and smart street lighting.

"Interest in and focus on Smart Cities has skyrocketed in 2017, with a very large number of vendors from across the value chain repositioning and optimizing their IoT portfolios to take advantage of this beckoning opportunity," says Dominique Bonte, Vice President at ABI Research. "By its very nature of aggregating a wide range of solutions and technologies, the Smart Cities segment offers the perfect environment for suppliers to offer horizontal IoT platform solutions and addresses a recent trend toward more holistic, cross vertical approaches."

When considering IoT revenue categories, the largest rewards can be reaped from the higher levels of the value chain, including applications and services, analytics and AI, and security. Connectivity, sensor and device management, as well as professional services, represent decreasing opportunities against a background of increasing platformization and commoditization.

Key smart city IoT solutions and platforms include Cisco's Kinetic for Cities, InterDigital's Chordant, PTC's ThingWorx, Microsoft's CityNext, Huawei's OceanConnect, Nokia's Impact, NVIDIA's Metropolis, Verizon's NetSense (Sensity), Siemens' MindSphere, IBM's Watson IoT, SAP's Leonardo and Amazon's AWS IoT platform.

[8] Top Smart City Projects to Watch in 2017, DZone / IoT Zone, March 02, 2017.

Many IoT technology suppliers are focusing on smart cities but only the ones addressing the specific challenges cities are facing will win. Critical success factors include flexible, extensible "as a service" aka "pay as you grow" offers, financing and ecosystem support, standards-based interoperability, and guaranteed technology lifecycle management.[9]

2018 Smart City Predictions, DZone / IoT Zone, Dec. 15, 2017.

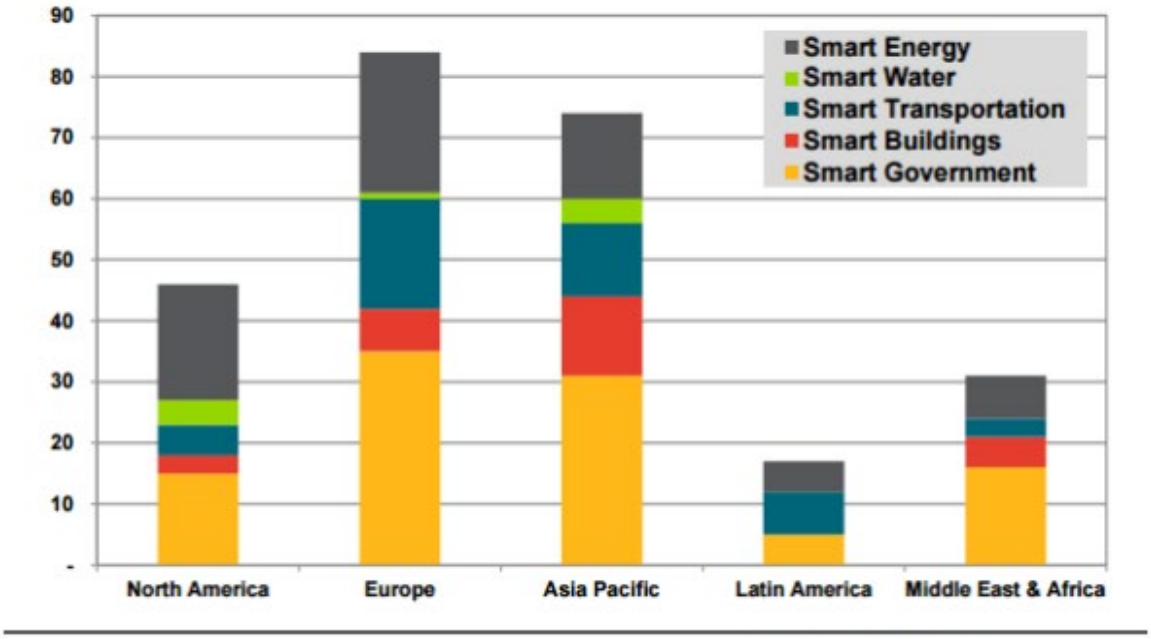
R&D

There are more than 250 smart city projects underway across 178 cities around the world, according to a new report from market research company Navigant Research.

The Smart City Tracker 1Q17 examines global smart city development, covering smart energy, smart water, smart transportation, smart buildings, and smart government sectors, segmented by region.

The report finds that, of the 252 smart city projects tracked, most projects are smart government-led (40 percent), with smart energy coming a relatively close second (27 percent). Smart transportation (18 percent), smart buildings (11 percent), and smart water (four percent) projects made up the rest.[10]

Chart 1.1 Smart City Projects Involving Each Industry Sector, World Markets: 1Q 2017



(Source: Navigant Research)

[9] Global Smart Cities IoT Technology Revenues to exceed US$60 Billion by 2026, Cision PR Newswire, Jan. 16, 2018.
[10] Smart city development now a global phenomenon, says Navigant Research, March 20, 2017

Mergers & Acquisitions

One indicator of the maturity of any technology market is merger and acquisition (M&A) activity. When robust, it is worth beefing up your company's compacity to compete.

Internet of Things Focus
The acquisition of sensor network company Sensity by telecoms giant Verizon is the latest example—and one of the most significant. Sensity provides sensors and network controls for street lighting systems and has been targeting the emerging market for city platforms. Another is Cisco's $1.4 billion acquisition of IoT platform provider Jasper Technologies in early 2016. Moves from other big players for sensor technology and IoT platform providers are likely in the works.

Analytics Companies
It is not only IoT technologies that are being acquired; analytics companies are also on the shopping list. Urban Engines, a specialist in the use of advanced analytics for the Internet of Moving Things, has announced that it is to become part of Google Maps. Founded by former Google employees, this may be more of a homecoming than an acquisition. However, it suggests that some of the more niche analytics providers in the smart city space will eventually find their home as part of a broader platform offering from bigger players.

Application-Specific Solutions
The third area of the market that we can expect to see more M&A activity is in application-specific solutions. This is an area with a greater history of activity. IBM, for example, has been adding to its roster of government solutions for a number of years in areas like intelligence and social care. But there has been less activity in new application areas. One exception is Silver Springs Networks' move to strengthen its hand with the acquisition of street lighting software specialist Streetlight.Vision. If acquisition activity is stepping up across the market, the next phase could see more activity in other emerging solution areas such as smart parking and smart waste.[11]

P3 Global Management (P3GM - www.p3gm.com), a global smart city development company announced July 20, 2017 that it has been acquired by EYSA, a leader in smart mobility solutions, in an all cash-transaction.[12]

Verizon has made another acquisition to build out its IoT business: the carrier has purchased LQD WiFi, a developer of outdoor interactive displays that provide WiFi connectivity along with news, emergency alerts and community information. They also act as sensors collecting crowd, weather and other data.[13]

Acquisitions in Internet of Things - Index, 2017.

[11] Is the Smart City Market Entering an Acquisition Phase?, Navigant Research, Sept 19, 2016.
[12] EYSA Announces Acquisition of P3GM a Leading Smart City Development Company, Cision PR Newswire, July 20, 2017.
[13] Verizon Buys LQD WiFi to Expand its IoT Strategy into "smart cities," TechCrunch, Nov 14, 2016.

Research Groups

Smart Cities Research Briefs

BU Center for Information & Systems Engineering
Boston University researchers are developing concepts, systems, and applications designed to make city life more efficient, cleaner, safer, and less costly than ever before. Collaborating with experts in academia, government, and industry, BU faculty and students are advancing Smart Cities systems and technologies as well as exploring economic, environmental, and public policy implications.

Georgia Tech Smart Cities

Columbia University in the City of New York Data Science Institute
Research conducted by the Smart Cities Center develops and monitors sustainable urban infrastructure and buildings, improves the power supply through smart grid technology, detects and counteracts problems with aging urban infrastructure, calculates and communicates optimal transportation routes under congested traffic conditions, and deploys ubiquitous sensing devices to facilitate everyday activities in a crowded urban environment. The Center is housed on the Morningside campus.

UC Berkeley Smart Cities Research Center
The center is a joint initiative of UC Berkeley ITS and Lawrence Berkeley National Lab. Its goal is to establish research and educational platform to support development of energy-efficient transportation systems of the future.

Smart Cities @ NC State University
Experts anticipate as many as 30 billion connected devices globally by 2020. Consequently, there is a need to bring together communities of researchers, experimenters and developers in wireless technologies to address growing needs of ultra-high-speed, high-bandwidth and low-latency (rapid-response) wireless connectivity.

ENABLE will bridge the gap between academic research and citizens, improving the human condition by making wireless networks pervasive, smart, resilient and secure.

Smart City Research
The Internet of Things (IoT) is a new paradigm that combines aspects and technologies from ubiquitous and pervasive computing, wireless sensors networks, Internet communications protocol, sensing technologies, communication technologies, and embedded devices. Smart Cities are advancing towards a pervasive, integrated, and intelligent environment, where IoT is used to seamlessly interconnect, interact, control, and provide insights about the various silos of fragmented systems within cities. The huge number of interconnected devices as well as the significant amount of data generated by them provides unprecedented opportunities to solve urban challenges. These technologies are merged together with city systems to form an environment where the real and digital worlds meet and are continuously in a synergetic interaction.

Conclusion

Cities are powerful engines of economic growth, fueled by intensive interpersonal communication and high concentrations of specialized skills. Urbanization's advantages are however mirrored by significant sustainability challenges, with cities today accounting for over 70 percent of global greenhouse gas (GHG) emissions and 60-80 per cent of global energy consumption.

Given that an estimated 70 percent of the world's population will live in cities by 2050, sustainable urbanization has become a key policy point to administrations across the world.[14] As such, developing smart cities is critical to operating within budget constraints while enhancing services to citizens.

[14] Focus Group on Smart Sustainable Cities.