WHITE PAPER

Understanding Smart City Transformation with Best Practices

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Today, more than one-half of the world’s population live in cities. According to United Nations (UN), the shift from a rural to primarily urban population will continue for the next couple of decades, creating further pressure on city infrastructure and resources. To cope with the influx of new inhabitants and ensure quality of living conditions for their citizens, many cities are now looking to develop and implement solutions with a key focus on technology, community engagement, and transparency. These cities are increasingly described with the label Smart City.

IDC defines a Smart City as a city undergoing the process of the digital transformation of its urban ecosystem to meet environmental, financial, and social outcomes. Cities, towns, counties, and states use data and technology to enable this urban transformation. However, this transformation is a long-term and complex undertaking. City stakeholders across the globe face issues such as understanding technology requirements, finding the necessary skills, clearing procurement roadblocks, funding, and implementing policies for governance, security, privacy, and open data.

To succeed with the transformation that the Smart City concept requires, cities need to be able to assess their current situation and determine the critical capabilities needed. After defining short- and long-term goals and plans for improvements, they need to prioritize technology, partnership, staffing, and other related investment decisions accordingly. They can also benchmark themselves against other cities to identify gaps and monitor the desired status within a given time frame. Indeed, such benchmarking allows cities to accelerate their Smart City initiatives using lessons learned from the best practices and success factors of their peers.

IN THIS WHITE PAPER

A tremendous amount of effort is going into Smart City initiatives around the world. This IDC White Paper aims to provide a better understanding of the global Smart City landscape by describing initiatives from cities all over the world. The paper also introduces IDC's Smart City MaturityScape, a tool that provides a roadmap for Smart City transformation by identifying the stages of maturity, best practice dimensions, and critical measures that determine the outcomes and actions required for government leaders to effectively develop a Smart City.

SITUATION OVERVIEW

Smart City programs are key to addressing urban challenges, as they harness the power of technology, drive local innovation to create jobs, grow local business, and provide a higher quality of life for residents. However, to reduce the investment risk, cities need to better understand the key drivers and implications of Smart City projects, as well as what successful cities are doing to fully realize the tangible benefits.
Key Smart City Drivers

There is a broad set of social, economic, technological, and environmental factors driving Smart City investments. These include:

- **Growth in urban population**: Urban population growth strains city infrastructure and resources, more so in less developed regions of the world. Urban areas in developing countries absorb most of the global population increase. According to the UN (2015), 67% of people will live in cities by 2050.

- **The Impact of climate change**: The impact of severe weather patterns and climate departure has emerged as a critical risk factor. Most cities today often lack the capacity to quickly develop measures to respond to climate change and need to get smarter in the fight to prevent climate departure.

- **Adoption of 3rd Platform technologies**: The 3rd Platform (Big Data analytics, social, cloud, and mobility) remains one of the main drivers of Smart City development, offering transformational technologies that are changing the way in which cities operate.

- **Resiliency and pressure from the digital citizen**: In this age of global interconnectedness, citizens increasingly demand technologies and tools to help them remain connected to the city so that they can remain informed, maintain strong social connections, and rely on ongoing services such as electricity.

**FIGURE 1**

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**Key Smart City Drivers**

- Growth in urban populations
- The impact of climate change
- Technology innovation & disruption
- Resiliency and pressures from the digital citizen

Source: IDC, 2015

Smart City projects drive (and require) a set of fundamental changes in how cities function. These include:

- **New funding models and partnerships**: Smart City projects, which can require specialized skills and be capital intensive, push governments to explore partnerships and revenue sources with organizations outside municipal government such as academia, non-governmental organizations, and the private sector, bringing access to expertise and offering new funding models such as public-private partnerships (PPPs), vendor financing, and performance-based contracts.
FIGURE 2
Potential Partners in Smart City Initiatives

- **Use of data for new insights and new solutions**: Cities generate huge amounts of data from multiple sources such as video cameras, environmental sensors, mobile devices, digital forms, and paper-based processes. This data can be analyzed to provide a better understanding of the root causes of challenges, and insights into how to enhance city operations.

- **Improved transparency and community engagement**: Smart City projects require government participation, which in turn necessitates improved government transparency and citizen engagement. Open data policies emerge as fundamental Smart City components, which actively promote government transparency and civic engagement.

- **Need for new skills**: Digitally intensive Smart City projects drive the need for human resources with critical competencies such as security, enterprise architecture, data sciences, and IT executive leadership.

FIGURE 3
Smart City Brings Fundamental Changes to City Operations

Source: IDC, 2017
Emerging Technologies Offer Solutions

Smart City solutions, by definition, are 3rd Platform initiatives. Smart Cities have arisen from the intersection of cloud, mobile, social, and Big Data technologies, as well as the internet of things (IoT). The effect of using these technologies in a city context is both cumulative and transformative.

- **Cloud** offers a cost-effective platform on which Smart City applications and services can reside and be easily maintained. Cloud also plays a fundamental role in horizontally integrating the data silos that are created by city applications, such as traffic and waste management, and weather and city transport information. These applications can constantly exchange data with one another to improve customer service, streamline Smart City processes, and generate new revenue streams.

- Smart Cities also use **IoT** devices that extend internet connectivity beyond traditional devices (e.g., smartphones) to a range of IoT devices such as connected sensors, lights, and meters to collect and analyze data. These devices collect analog or physical information and transform it into digital information to be analyzed by analytics tools at a later stage.

- **Big Data analytics** helps cities obtain valuable insights from the large volume of data collected through various devices, including IoT devices. The combined effect of IoT and Big Data analytics is transformational. For example, identifying and obtaining valuable information from large volumes of weather data can be beneficial in terms of agricultural development, while weather data analysis can also help inform people in advance about possible hazardous conditions such as floods or extremely hot weather.

**FIGURE 4**

Emerging Technologies Offer Solutions

Blockchain is also emerging as a transformational tool for Smart Cities, providing a viable alternative that eliminates transactional intermediaries, thereby lowering operational costs. Early adopters in the public sector are engaging in innovative next-generation service delivery for public services such as tax collection, identity management, and land and property title registration.
Smart Cities: From Concept to Step-by-Step Transformative Implementation

Until recently, most discussions of actual Smart City implementations centered on a group of cities that were leading the way in innovations and embracing the Smart City concept. Singapore, Seoul, Barcelona, Santander, Helsinki, Copenhagen, Amsterdam, New York, Boston, Chicago, and San Francisco are some of the cities that have provided examples of successful initiatives. The leading cities have certain specific areas of excellence such as Singapore's vision and New York City's citizen engagement initiatives.

In the past few years, more and more cities have followed these leaders and begun to implement Smart City projects. Examples of fast followers include Montreal, London, Bristol, Leeds, Manchester, Glasgow, Hamburg, Vienna, Hong Kong, Nice, Madrid, Miami, Los Angeles, Moscow, Istanbul, and Dubai. These are the cities that are ahead of most others in their Smart City outlook. They understand the benefits of Smart City initiatives and have moved forward with strategic plans or pilot investments. They are innovative and willing to take risks to catch up with the leaders. Dubai, for example, is a regional risk-taker and trendsetter in terms of adopting digital technologies in governance and adjusting policies and regulations to adapt to rapid societal changes and technological advances. Istanbul has also recently initiated a comprehensive consulting study with the involvement of public- and private-sector entities, universities, non-governmental organizations (NGOs), and citizens to achieve a fast, integrated, and people-oriented Smart City transformation.

In addition to the above-mentioned cities, there are several examples of thriving cities like Graz, Porto, Cork, and Valetta that closely follow the innovative cities to learn from their experiences, identify measures suitable for their specific local context, and develop a replication plan tailored to their local needs. Graz, for example, is looking to invest in cleaner energy and transport by replicating Smart Energy solutions from leading European Smart Cities.

IDC's Smart City MaturityScape Stage Overview

IDC's Smart City MaturityScape has five stages: ad hoc, opportunistic, repeatable, managed, and optimized. A description and expected business outcome are described for each stage in the sections that follow. It is important to note that each stage builds on the capabilities of the previous one.

- **Ad Hoc:** Cities or departments have few projects or initiatives that are identified as transformational or Smart City, and those that do exist are tactical, ad hoc, and department-based, without attention to broader strategic issues around governance structures or citywide coordination. The goal of the ad hoc stage is to begin to prove the value of the Smart City concept and develop the business case via demonstrated success from pilot projects. The success of these projects is largely based on the technologies used as opposed to changes made in organizational structure and/or processes such as how projects are justified, budgeted for, and governed/controlled.

- **Opportunistic:** Cities and departments ramp up their Smart City efforts as executive sponsors and key stakeholders buy into the concept and start to provide leadership and strategic direction. Success from initial pilots provides understanding and may result in proactive collaboration between departments. Open data policies are starting to be developed as internal data-sharing tools, and some data sets are open to the public. At this stage, the foundation is laid for sustainable governance and organizational structures, which provide the business case to help incrementally increase the Smart City budget.

- **Repeatable:** Cities and departments are increasingly driven by a consolidated multiagency Smart City strategy built on recurring projects, organizational structures, events, and processes identified for integration and buildout based on improved outcomes. The goal of the repeatable stage of maturity is improved outcomes and service delivery, as a result of
repeatable, standard processes for Smart City projects, better use of information, and the coordination of initiatives beyond the department level and with outside partners (i.e., national government agencies, academia, and the private sector).

- **Managed**: The Smart City strategy is accepted citywide and formalized with documentation, KPIs, and timelines for achieving specific goals. Strategy is implemented by a formal Smart City team that has its own funding and supports budgeting for programs across departments. Outside of local government, an ecosystem of other government entities, academia, citizens, and private suppliers support the Smart City vision with sustainable business models. At this stage, the benefits of Smart City investments are realized in a sustained way as part of the city fabric.

- **Optimized**: A sustainable citywide platform is in place to provide agile strategy, IT, and governance, which allows for autonomy within an integrated system of systems. A process focused on continuous improvement delivers superior outcomes and differentiation. A culture of innovation and partner engagement coupled with technology investments in cloud-based open platforms, ubiquitous wireless broadband coverage, and edge data collection devices support key outcomes. Mature Smart Cities will attract business investment, visitors, tourists, and citizens, because they provide high-quality citizen services, are easy to do business with, and offer a higher quality of life.

Figure 5 provides an overview of the five stages of the Smart City Maturity Model, the key characteristics of each stage, and the expected business outcomes of each stage.

**FIGURE 5**

IDC's Smart City MaturityScape Stage Overview

Source: IDC, 2017
Why Is Benchmarking Important for Cities?

Benchmarking can help city managers learn from the mistakes and successes of their peers as they tackle Smart City challenges. Indeed, by benchmarking against other cities and regions in the country, they can see the prime examples of best practices in individual areas and learn from them. Additionally, Smart City projects are costly undertakings, and local officials must ensure the efficient use of public money. Central authorities and city councils alike are therefore right to demand analysis of how money is spent and how far the city has advanced in comparison with its peers. Certain specific funds (e.g., EU funds) have required outcomes such as sustainability adherence, thus requiring cities to track and measure progress. It is important to collect data in order to show the results and improvements from Smart City initiatives and to highlight the increase in the institutional capabilities of the city in question, which helps ensure the continuing environmental sustainability of the project. In fact, the definition of a Smart City relies on outcomes-based transformation, underlining the importance of tracking key performance indicators (KPIs) and measuring progress.

Smart City Benchmarking Using IDC's MaturityScape

The overall Smart City maturity evaluation gives a wide, overall picture of the current situation, but for IT executives and other senior leaders to optimize their decision-making, a deeper look is required. IDC’s Smart City MaturityScape framework identifies five stages of maturity, five best practice dimensions (strategy, culture, process, technology, and data), and 19 critical measures to effectively develop a Smart City.

Dimensions of IDC’s Smart City MaturityScape

At each stage of IDC’s Smart City MaturityScape, organizations should consider five dimensions, each contributing to the ability to advance toward higher levels of Smart City competency and maturity:

- **Strategy:** This includes the Vision, Leadership, Business Case and Budgeting of Smart City strategic development.
- **Culture:** This dimension is focused on the three key areas of Innovation, Citizen Engagement, and Transparency.
- **Process:** Governance, Partnerships, Organization Structure, and Measurement are the key components of this best practice dimension.
- **Technology:** 3rd Platform-ready IT architecture, IoT Adoption, and Citizen Data Architecture, as well as Innovation Accelerators Adoption are essential technology components in Smart City development.
- **Data:** This best practice dimension focuses on Citizen Data Protection, Open Data Discovery & Analysis, and Data Sharing.
FIGURE 6

Process Measures of Smart Cities: Five Dimensions and 19 Success Areas

The benchmarking model defines the behavior of each of the 19 categories above for the five stages of Smart City maturity. Cities are scored based on the self-reporting of their behavior in each of these categories, which determines the maturity of the city on a 1-5 scale. The benchmark therefore not only provides detailed information on each category, but it is also able to aggregate the evaluation result into a single number (or set of numbers).

Figure 7 is an example of practical implementation of Smart City benchmarking using MaturityScape. The figure shows the aggregate maturity level of Western European (WE) Smart Cities. The cities included in this benchmarking study are large metropolitan areas such as Barcelona, Amsterdam, Helsinki, London, Madrid, Copenhagen, and Paris, as well as medium-sized local governments, such as Santander, Issy-Les-Moulineaux, Bristol, Milton Keynes, and Aarhus.
Interestingly, the majority of WE cities are in the early adoption phases of Smart City implementations, with 44% of respondents in the ad hoc stage, and 9% at the opportunistic level. This is understandable given the overall market's early levels of adoption, pressure to cut expenditure, and the fragmentation of initiatives. In fact, many cities have started pilots in the field of energy management, through Smart Metering, intelligent transportation, and environmental monitoring, by leveraging EU funds, such as the Horizon 2020 Energy Challenge program. Nevertheless, they have struggled to scale up from pilot to full operations, and cities that managed to scale up have still not integrated capabilities beyond the narrow boundaries of a single city department.

It is also very interesting to note that 24% of respondents are at the managed stage. This reflects the fact that across WE countries, some visionary leaders have leveraged EU funding and national programs more decisively than others, such as the Plan Nacional de Ciudades Inteligentes in Spain, the Innovate UK IoT cities demonstrator, and the Italian Ministry of Education, University, and Research funding for Smart Cities. They have also created innovative governance arrangements for sustainable collaboration across a broad ecosystem that includes ICT suppliers, utilities, transportation companies, engineering and construction companies, academia, and non-profit organizations. Cities at the Managed stage have also used open data initiatives as a platform to stimulate digital innovation, rather than only as a transparency program. Examples of leader cities include large metropolitan areas (e.g., Barcelona, Amsterdam, Helsinki, London, Madrid, Copenhagen, and Paris) and medium-sized local governments (such as Santander, Issy-Les-Moulineaux, Bristol, Milton Keynes, and Aarhus).

However, it is important recognize that even these leading cities in WE have rarely achieved a fully sustainable innovation process that enables city-wide improvement. In fact, less than 10% of organizations and processes can be considered Optimized. There are no known demonstrable examples of cities that can legitimately claim to be optimized across the above-mentioned 19 success areas and five dimensions for all functions within a city, such as law enforcement,
transportation, citizen services, and so on. This means that even if a city is a leader, the benchmark still provides useful guidance on how to further improve.

Discussion of Best Practices

The dimensions of IDC’s MaturityScape (Strategy, Culture, Process, Technology, and Data) also refer to best practice areas. Although no single city has excelled in all practice areas, there are numerous Smart City implementations that have achieved excellence in one or more practice areas.

Strategy

This includes the Smart City vision, leadership, business case, and budgeting. The vision statement for a Smart City often describes what the community will look like in the future in areas such as transportation, housing and urban development, and public safety, as well as how it will address opportunities and challenges. The vision needs to be publicly communicated by senior city leadership – often by the Mayor or a team of high-level city officials. Strategy also includes business case development to justify the investment with measurable financial, social, and environmental benefits, with detailed budgeting studies attached to the business case.

Strategy Best Practice #1

The first step in becoming a Smart City is to have a vision that is clearly articulated and documented in a plan that contains short, medium, and long-term goals.

Singapore is one of the pioneers in the development of a formal Smart City vision statement. With its “Singapore: Smart Nation” vision, Singapore aims to become an "Intelligent Nation, A Global City, Powered by Infocomm", where people are empowered by technology to lead meaningful and fulfilled lives. Singapore’s Smart City strategy, in addition to being supported by a clearly articulated vision, is bolstered by a plan called Intelligent Nation Masterplan (iN2015). The iN2015 plan is one of the best examples of a Smart City strategy document that discusses an internal view supporting businesses and citizens, with a goal to export product and service innovations to other cities around the world.

According to the report published by the iN2015 steering committee, Singapore’s iN2015 strategy includes four key strategic goals:

- To build an ultra-high-speed, pervasive, affordable, and trusted next-generation national infocomm infrastructure
- To compete more effectively internationally with innovative “made in Singapore” products, services, and solutions
- To develop an infocomm-savvy workforce and globally competitive infocomm talent pool in Singapore
- To harness infocomm technologies to transform key industries (i.e., financial services, manufacturing, and tourism)

The strategic plan also lists the desired outcomes as:

- Enriched lives through infocomm
- Enhanced economic competitiveness and innovation through infocomm
- Increased growth and competitiveness of the infocomm industry
The end goals, with measurements, are:

- To be number one in the world in harnessing infocomm to add value to the economy and society
- To realize a two-fold increase in the value-add of the infocomm industry to $26 billion
- To realize a three-fold increase in infocomm export revenue to $60 billion
- To create 80,000 additional jobs
- To achieve 90% home broadband usage
- To achieve 100% computer ownership in homes with school-going children

Along with high-level strategic goals, Singapore has also very specific performance metrics for tracking its success.

**Strategy Best Practice #2**

Be sure to have strong top-level support for the city leaders who will authorize others to push the Smart City agenda forward.

Singapore’s Smart Nation Program is coordinated by the Prime Minister’s Office and supported by the IDA (the city-state’s technology office), as well as other government agencies. This governance structure points to another best practice—cities that are serious about the Smart City concept developed a dedicated office for the program that reports directly to the mayor.

**Culture**

This best practice area refers to the culture of innovation, transparency, and citizen engagement within a city. Processes and tools should be in place to generate and implement new ideas from both government workers and citizens. The development of a culture of innovation and citizen engagement is a city-wide function involving citizens, local businesses, and government vendors, with funding and authority given to a cross-departmental innovation leader or team. This includes testing and experimenting with new and existing processes, models, relationships, and technologies to solve long-standing issues. Innovation requires the ability to experiment and collaborate using an iterative process built upon successes and failures over time.

An innovation strategy is often formalized by a city’s mayor and put into practice by a support team of doers. City innovation needs to be continuously fed by new ideas from multiple city stakeholders (government workers, citizens and community groups, academia, IT vendors, and local businesses). Bringing innovation to a city also requires a management system, with specific roles and responsibilities like chief innovation officers (CINOs), metrics, processes, resources, and governance.

**Strategy Best Practice**

Formalize Innovation as a city-wide function with funding and authority given to a cross-departmental Innovation leader or team.

One of the first examples of this type of organization is the Office of New Urban Mechanics (NUM) in the city of Boston, which is based in the mayor’s office. The NUM focuses on fostering cultural change from within, incubating new ideas and experimentation, identifying innovators, educating and providing information to stakeholders inside and outside local government about its work, and helping to set up similar innovation offices in other cities.

Although most cites lack a formalized innovation strategy of the kind described above, many cities now look to increase citizen engagement to support city innovation. There are also some successful examples of citizen engagement by cities that are at the forefront in this area:
• **Gathering and disseminating citizens' key information using social media:** Social media is an effective way of citizen engagement that can foster a sense of connection and give citizens an easy way to provide information and feedback to government. Sweden’s government is well known for its Twitter experiment that started in 2012, when the tourism board began allowing Swedish citizens to curate the content of the official country of Sweden Twitter account for a week. Similarly, a guest curator takes over Ireland’s @ireland Twitter account each week, sharing messages and information about their personal interests and experiences.

• **Gathering and disseminating citizens' key information via mobile apps:** Mobile apps are now moving beyond 311-type apps that register complaints about non-emergency situations like abandoned cars or illegal dumping. Seattle’s Find It, Fix It app lets residents report hazards or indecencies to the city authorities, like abandoned vehicles, graffiti, and potholes. Users simply take photos of the issue within the app, write additional details, and mark it on a map. With innovations of this kind, the city is gathering data and working toward a transparent exchange of city information.

• **Supporting city innovation with crowdsourcing:** Some cities are investigating crowdsourcing for generating and selecting ideas for ICT innovation in a city context. Future Melbourne was one of the most interesting and earliest projects initiated by the City of Melbourne Council, which asked citizens to help write the city plan. In its early days, the wiki (a website that allows collaboration) encouraged citizens to share ideas and edit the content of the Future Melbourne draft plan, which discusses key issues like facilities for the homeless, the use of arts to promote equity and inclusion, and smarter public transport.

**Process**

The process dimension considers governance, partnerships, organization structure, and measurement. Many of the challenges that Smart Cities currently face cannot be met with traditional processes of governing, and successful change consequently requires new and innovative forms of governance. Smart City governance should not only be about what governments do, but also about the outcomes of interactions between all actors in the public domain. Partnerships are also very important to Smart City development, as collaboration between ICT vendors, academia, private industry, and citizen groups is necessary, for both deploying smart solutions and for creating innovation ecosystems for using emerging technologies.

Best Practice #1

Create a team of key partners that will help the city deliver urban services in new ways or via new business models.

Innovation in partnerships and engagement models is a necessity for Smart City development. Government and academia have always worked together, as have government and the private sector. However, we are now seeing more relationships that are focused on the co-development of products and solutions with a strong focus on two areas, namely outcomes and revenue generation. Some cities are co-developing projects with IT vendors and academia with future revenue-sharing or product ownership options for the city, while others are adopting performance-based contracting, in which the vendor shares the risk with the city and ensures cost savings or ROI over a long period of time (i.e., 10+ years). Some cities are also creating new partnership structures that allow them to procure services from partners more easily.
When considering the need for changing governance and partnership models in a Smart City context, pertinent questions include:

- Are the objectives of Smart City initiatives relevant, appropriate, and aligned with broader city development goals?
- Does the initiative address important problems for the city in question?
- Are there new funding and investment models that vendors and cities can develop specifically for Smart City initiatives?
- Is there a type of PPP that is best suited for Smart City projects, or do new partnership models need to evolve?

Answering the above questions can lead to innovations in engagement models between cities and IT vendors and help cities decide upon the best partnership model for them.

The City of New York formed an innovative partnership in 2014 with CityBridge (a consortium comprising Qualcomm, Civiq, and Intersection) to finance and fund LinkNYC – a $200 million infrastructure project designed to replace legacy phone booths with 7,500 digital kiosks throughout the city and provide citizens with free domestic calling, phone charging ports, a 911 emergency call button, high-speed WiFi, and city information. Under this partnership, the city granted concessions to allow the consortium to install the kiosks and collect advertising revenue, which was shared with the city at an agreed rate and used to cover the costs of installation, equipment maintenance, and digital advertising operations.

**Best Practice #2**

**Restructure city governance to align with Smart City vision and support with new regulations where needed.**

Barcelona is worth mentioning with regard to its best practice in governance. Barcelona’s strong Smart City vision and leadership were demonstrated by the restructuring of several of its local government departments to align with its Smart City vision. In July 2011, the mayor of Barcelona, Xavier Trias, began to enact his Smart City vision, which had three fundamental pillars:

- Local projects: Focusing on the better use of technology to improve the lives of citizens.
- International vision: Creating a scalable platform to ensure that Smart City projects are rolled out in a replicable way.
- Technology standardization: The development of the City Protocol (launched in July 2012) to drive the way in which technology standards should be developed specifically for cities.

Trias reorganized the city council and created the Urban Habitat (Smart City) department, a new structure combining the urban planning, environment, IT, and infrastructure and transportation departments under the leadership of Deputy Mayor Antoni Vives. The purpose of this new organization was to break down the traditional silos that inhibit the delivery of next-generation citizen services. For example, the department coordinated all of the services on city streets, from lighting to parking to road repairs, as opposed to different departments having responsibility for each area. This change involved a redefinition of processes, responsibilities, and communication channels, and an investment focus on technology innovation. Central to Trias’s effort was to institutionalize his vision by reorganizing departments and creating the Urban Habitat department, as well as supporting these changes with regulations. For example, Trias’s government passed a bylaw called MES (mobility, egovernment, and Smart City) that institutionalized the long-term vision of the Barcelona Smart City.

The new city governance headed by Ada Colau has adopted a very different urban vision of "collective intelligence", which aims to transform conventional politics and government systems.
through public debates on the implications, rights, and technopolitics of the digital revolution. In line with the new vision, the name of the Smart City department changed from Urban Habitat to Urban Ecology, reflecting the new government's role in protecting and administering the urban environment, thereby increasing the sense of belonging in the city for citizens. Despite this radical change in the urban vision, the well-established formal participatory institutions remained fundamentally unchanged. However, significant changes were observed both in the fields of discourse and practices, such as the proliferation of transparency, open government, Smart Cities, and social innovation, as these concepts are used in different ways by the former government and numerous participation and collaboration initiatives driven from below by citizens.

**Technology**

The technology dimension includes 3rd Platform architecture, IoT adoption, citizen data architecture, and innovation accelerators adoption. Technology is regarded as an enabling force in the development of smart and sustainable cities.

**Best Practice #1**

*Ensure that connectivity is universally accessible and affordable. To achieve this, create a connectivity strategy that goes beyond traditional wireless access and incorporates Instrumentation (i.e., the Smart City Internet of Things).*

Connectivity technologies are traditionally the fundamental elements of Smart Cities. This includes wireless connectivity and access across the city, enabling citizens, tourists, and businesses to access the information and services that are now offered via mobile apps, social media, and mobile-optimized websites. An important part of today's Smart City is the IoT, which extends internet connectivity beyond traditional devices (e.g., smartphones) to a wide range of IoT devices (e.g., sensors and RFID tags) that communicate and interact with the external environment via the internet. These devices collect analog or physical information and transform it into digital information that can be analyzed at later stages. Therefore, a best practice area is how well-instrumented a city is or, in other words, how much data is being provided from "things" and how successfully this data is analyzed to extract useful information.

South Korea is arguably the world leader in internet connectivity, having the world's fastest average internet connection speed (as of 2017, 97% of the population has broadband internet access, with average speeds of around 26mbps). The country will also upgrade its wireless 4G networks to 5G by 2020, making it 1,000 times faster than it is now. To maintain its leading position as the world's most connected country, South Korea is continuously investing in connectivity technologies within a national plan driven by the Ministry of Science, ICT, and Future Planning (MSIP). The MSIP initiated IoT development projects in 2015 in collaboration with SK Telecom and Busan City as an initial step toward creating a nationwide IoT network. In 2016, South Korean firms Samsung Electronics and SK Telecom also started building a nationwide IoT network. The network was first rolled out in South Korea's fourth largest city Daegu, with an initial focus on infrastructure for renewable energy, cloud computing, and Big Data for healthcare and medical services, as well as infrastructure to accommodate electric cars and autonomous vehicles. Daegu is now serving as the test site for the wider IoT network planned to be deployed nationally. The planned IoT network is one of the world's first commercial Long Range Wide-Area Networks (LoRaWAN) to be deployed on a national scale.
Best Practice #2

Look to adopt a platform-based architecture that allows for data from multiple devices and sources to be used together for optimal decision-making.

Many devices and systems interact with each other in a Smart City. This illustrates the need for building a central point to aggregate data and functionality from many siloed city systems. Adopting a platform-based architecture helps cities with better resource planning, scheduling, route planning, and so on, although future uses will include broader urban planning goals. With a better understanding of traffic conditions and how populations move in cities, and the ability to predict energy use and consumption, city planners will be able to make better decisions regarding infrastructure investments, including where to build parks, roads, schools, libraries, and hospitals.

Barcelona provides a best practice use case in the development of a platform-based architecture for its sensors and devices. Barcelona’s Smart City platform, known as the Urban Platform, brings together data from the open source Sentilo network of sensors and actuators, the city’s information systems, and social networks, allowing it to solve urban challenges across silos. With the aim of overcoming the limitations of a vertical system, Sentilo is designed as a horizontal platform that facilitates sharing information between heterogeneous systems and the easy integration of legacy applications. The platform manages all the sensors installed in the city in real time, from traffic flow to ambient noise, and already processes 1 billion+ transactions that are received from the 14,000+ sensors with which it communicates.

Data

The data dimension covers citizen data protection, open data, data discovery and analysis, and data sharing. Cities already have a wealth of data in their current systems, as well as a flood of new data coming in every day. It is imperative that this data is protected, integrated, analyzed, and shared so that it can be used optimally in planning, production, and decision-making processes. This data was traditionally only used internally (i.e., a closed system where the data is generated), until some cities started to open this data to facilitate the creation of new services and business opportunities, as well as to support research and development (R&D).

Best Practice

Create an open data policy that will push each city department to take a data inventory and share it with each other as well as with citizens.

Open data is a component of today’s Smart City transformation initiatives. Citizens expect more government transparency, and data needs to be shared more freely across departments.

New York has developed one of the most innovative open data initiatives to improve the accessibility, transparency, and accountability of the city’s governance. Within this, citizens are provided with unprecedented access to data from over 1,400 New York State data resources on topics ranging from farmers’ markets to solar photovoltaic projects to social media usage. City agencies are obliged to keep the datasets under their purview up to date. Citizens can also submit feedback for a particular dataset, or suggestions for new datasets using the official website. The open data platform helps to improve the accessibility, transparency, and accountability of the city’s government, while increasing citizen participation in exploring how data and technology can improve the quality of life in New York.

Dubai’s Open Data Law is one of the first open data initiatives in the Middle East. As part of the Smart Dubai 2021 strategy, Dubai has also introduced an open platform called Dubai Pulse, which serves as the repository for all of the emirate’s data. Dubai Pulse compiles all available data from both the public and private sectors, while ensuring data security and integrity with its multi-layered data architecture. The top layer is only used by Dubai Government officials and entities, while the
middle layer contains thoroughly analyzed and saleable data fit for academic, professional, commercial, and economic purposes, and the bottom layer is freely available for public consumption. The open data platform will empower Dubai’s government to identify issues such as traffic accident hot spots and increase the contribution of citizens and academics to the planning, designing, and implementation of services to make Dubai a better place to live in.

**FUTURE OUTLOOK**

**Innovative Use of Technologies to Drive a New Wave of Disruption in Smart Cities**

The emergence of a number of technologies will drive a new wave of disruption in Smart Cities and improve citizens’ quality of life. The 3rd Platform will keep changing the way in which cities operate for the next 10+ years. In particular, IoT, artificial intelligence (AI) and deep learning, and (potentially) blockchain technologies will be the most transformative Smart City technologies.

- IoT has been applied for purposes such as traffic light systems and automatic number plate recognition for a number of years already. As IoT becomes increasingly ubiquitous, there are also new approaches to realizing its full potential, such as smart infrastructure development. The power management infrastructure recently built by Alibaba in Macau, China is an example of smart infrastructure development on a city-wide scale, whereby power systems will be autonomously managed and restored in case of any damage.

- AI and deep learning will be increasingly used to develop new city services, as well as to enrich existing services. Autonomous cars are no longer a thing of the future, as they are already being tested in Singapore by the start-up company, Nutonomy. Self-driving taxis are currently only operating within a 2.5-square-mile business and residential district, and pick-ups and drop-offs are limited to specified locations. Drones will soon start transporting people as well as carrying goods. In 2016, Chinese manufacturing company Ehang announced the production of new drones capable of carrying passengers. The company also stated that self-flying craft could be used as fully autonomous smart drone taxis. Video surveillance systems with inherent intelligent capabilities will be used not only to react quickly to dangerous situations, but also to predict crimes before they happen. When society is willing to trade privacy for security, these cameras are likely to be integrated with social networks such as Facebook and Twitter to eliminate any kind of criminality.

- Blockchain will also transform cities, in areas ranging from governance and healthcare to energy. Early blockchain adopters in cities are engaging in a level of innovative next-generation service delivery. In America, the state of Illinois, for example, has recently started working on a blockchain pilot focused on the digitization of birth certificates. As part of this pilot, businesses and governments will be able to verify and authenticate a citizen’s identity by requesting encrypted access. Meanwhile, LO3 Energy has teamed up with Siemens in Brooklyn, New York to create a pilot microgrid using blockchain. Residents with solar panels can sell excess energy to their neighbors in a peer-to-peer transaction that takes advantage of blockchain technology. In addition to specific use cases, blockchain, being inherently distributable, will be used to mitigate some of the security risks associated with the current centralized IoT ecosystem in Smart Cities. Blockchain’s strong protections against data tampering should help prevent a rogue device from relaying misleading information to disrupt a home, factory, or transportation system.
Digital Data (Supported by Open Data Initiatives) Will Potentially Become a New Source of Income for Cities

Cities will expand their thinking regarding open data and increasingly view it as a potential source of new services and revenue. Some cities are considering how to combine data from the private sector, utilities, and government to offer more powerful information that can be bought and sold. The City Data Exchange (CDE) in Copenhagen, Denmark was one of the first examples of experimentation with datasets from different public and private entities on the same cloud-based platform and a marketplace for that data. The CDE aggregates, cleanses, and then brokers the sale and exchange of public, privately owned, and open datasets for new Smart City applications. The longer-term impact of such initiatives is digital data potentially becoming a new source of income for cities, as well as a new source of service innovation.

Asia to Drive Global Smart City Growth

Emerging economies such as China and India are investing heavily in Smart Cities that are intended to be models of sustainable urban life, combining the latest high-end technologies with state-of-the-art architectural design, fully integrated into urban environments. India is also developing an astonishing 100 new Smart Cities, in addition to converting 500 other urban areas into Smart Cities. China is also on the right track to catch up with global Smart City developments. More than 270 Chinese cities have been chosen for pilot projects thus far, which they have been intensively evaluating for the last two years, and which will be replicated nationwide. The Philippines is carrying out a project in collaboration with China to build a new connected city outside Manila. The city is designed to become a self-sustaining smart community, whereby the city itself is run by AI. Unlike typical Smart City projects in the West, many Asian cities are building Smart Cities from scratch, and thus avoid costly legacy infrastructure upgrades. This gives Asian cities a further advantage in terms of the speed of development.

CONCLUSION

Cities are transforming in order to develop sustainably, improve resilience, meet citizens' rising expectations, and attract investment, new businesses, and talent. This is a complex undertaking that is not without challenges, especially when coupled with constrained financial resources, fast-growing populations, and aging infrastructure.

"One size fits all" is not a viable approach when embarking on a Smart City transformation journey. While every city is unique, and Smart City projects are complex, IDC's research has shown that cities face similar challenges in terms of strategy, culture, process, technology, and data, and can therefore follow a similar framework to achieve success. Cities should be measured on their abilities to connect various projects and create synergic effects, as well as the way in which they engage with their citizens. By using a city benchmarking model such as IDC's Smart City MaturityScape, city leaders can begin to set a roadmap for their Smart City initiatives, compare their progress against that of peers, and understand the investment and other factors necessary to move forward on the path to maturity. Additionally, city leaders can use benchmarking as a tool to develop a common language, improve collaboration in defining and executing a Smart City strategy, and promote and encourage the use of Smart City solutions.
LEARN MORE

Related Research

- IDC PlanScape: Distributed Ledger (Blockchain) Technologies in Smart Cities (IDC #US42354417, March 2017)
- Worldwide Smart Cities 2017 Predictions (IDC #US41863216, November 2016)
- IDC MaturityScape Benchmark: Smart Cities in Western Europe, 2016 (IDC #EMEA41513916, June 2016)
- IDC MaturityScape: Smart City (IDC #US40814315, December 2015)
- Internet of Things: Smart City Adoption and Market Trends (IDC #CHE42806017, June 2017)
- Smart City CY 2Q17 (IDC #CHE42413717, July 2017)

APPENDIX

About ISBAK

ISBAK is one of the leading Smart City solution providers in Turkey. As a subsidiary of Istanbul Municipality, its solutions serve more than 15 million people living in the city. The company now aims to transfer its 30 years of experience in Intelligent Transportation Systems (ITS) into Smart City solutions and become the "architect of smart cities" in Turkey and across the World.

ISBAK believes that each city has different problems requiring different solutions. In line with this, the company helps cities become smarter and more resilient by providing solutions tailored to their specific needs. ISBAK also offers consultancy services and carries out R&D activities to continuously improve its offerings.

ISBAK offers a broad range of Smart City solutions in Turkey and abroad, including:

- Intelligent Transportation Systems
- Transportation Planning and Geographic Information System (GIS)
- Safe City Management System
- Smart Lighting System
- Tunnel Management System
- Fleet Management System
- Consultancy for Smart City Transformation
- IoT-Based Cloud Traffic Management
- Control and Operations Centers for Metropolitan Areas
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