smart africa

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Smart Sustainable Cities: A Blueprint for Africa

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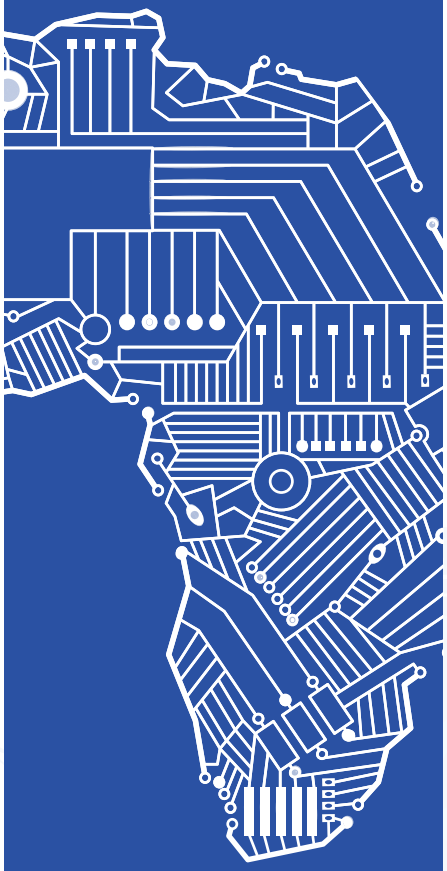
The Smart Africa Smart Cities Blueprint



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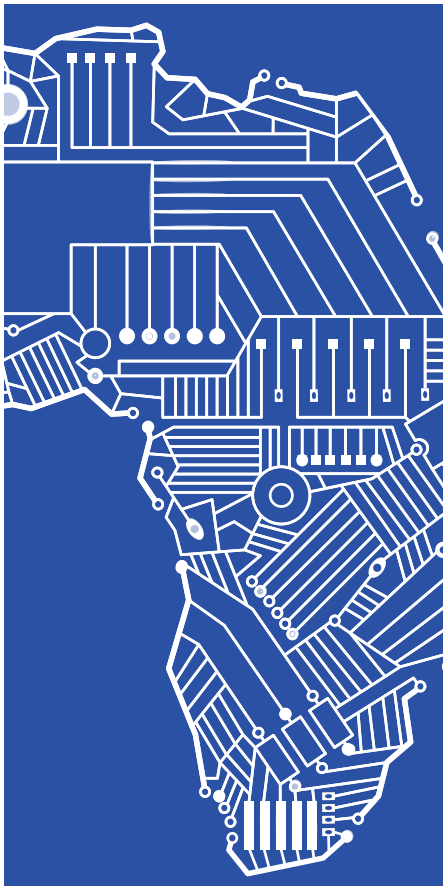

FIGURES

LIST OF ABBREVIATIONS

AU	**African Union**
DB	**World Bank Ease of Doing Business Ranking**
GDP	**Gross Domestic Product**
GIS	**Geographic Information System**
GPS	**Geographic Positioning System**
ICT	**Information Communication Technology**
ISO	**International Standards Organization**
MLD	**Millions of Liters Per Day**
SDG	**Sustainable Development Goals**

FOREWORD

Urbanisation is a powerful driver of economic development and social mobility. It is also catalyst for technological progress, as we see in cities globally. Africa is no exception. We are already home to the world's fastest-growing cities. It is estimated that half of Africans will be living in cities by 2030. This irreversible trend is fundamentally positive for our continent's prosperity.

But we have to think ahead. It is up to us to plan adequately for urban expansion by anticipating the higher standard of public services, housing, liveability, and economic opportunity that our citizens expect and deserve. I therefore commend the launch of Smart Africa's blueprint for smart, sustainable African cities. It provides an overview for policy-makers, scholars, investors, and citizens.

The report's key message is to integrate available technology at every level of urban management. Information dashboards powered by real-time sensors and data analytics can help to deliver better services at lower cost. But technology is not a panacea, and it does not run on auto-pilot. To get the cities we want, we must always keep the people we serve at the centre of our efforts. Technology alone cannot do that for us.

However, as this blueprint demonstrates, the 'smart cities' framework powerfully focuses our attention on the factors that make a city conducive to growth, health, and sustainability. It also offers a platform to bring all stakeholders together to find the best solutions for each individual municipality. Crucially, these technologies also provide new ways to track progress toward the goals we set, and for citizens to contribute actively to the process along the way.

Transforming Africa's cities will transform Africa. We have the means and the knowledge to do things differently and better — in a word, smartly.

Let's come together to make it happen.

H.E. President Paul Kagame, Chairman of the Smart Africa Board

ACKNOWLEDGEMENTS

The Transform Africa Summit held in Kigali, Rwanda in October 2013 culminated in the adoption of the Smart Africa Manifesto adopted by 7 African Heads of State. These country heads committed to providing leadership in accelerating development through ICT. Subsequently, the Smart Africa Manifesto was endorsed by the Heads of States and Governments at the 22nd Ordinary Session of the Assembly of the AU in January 2014 in Addis Ababa.

To operationalize the Manifesto, the Smart Africa Alliance was created. This is a coalition of African states, development partners and private sector members. The Alliance identified flagship projects led by member states to kick off the implementation of the Manifesto. One of these projects is Smart Cities led by the government of Rwanda which has developed this blueprint that cities across the continent can adopt as they embark on their own smart city initiatives.

I wish to acknowledge that the development of this blueprint was made possible by the commitment of numerous individuals and institutions who contributed their expertise and resources to see this project come to fruition. The Smart Africa Secretariat expresses its gratitude to the members of the technical committee on Smart Cities for Africa which is drawn from government, the private sector and development community specifically Ericsson, IBM, Intel, and UN-Habitat. It is through their enthusiasm, effort, and commitment that we see the realization of this project.

We are collectively grateful for the transformative leadership of H.E. President Paul Kagame and his peers on the Smart Africa Board – H.E. President Uhuru Kenyatta, H.E. President Yoweri Museveni, H.E. President Salva Kiir, H.E. President Ali Bongo, Ondimba, H.E. President Faure Gnassingbé, H.E. President Macky Sall, H.E. President Ibrahim Boubacar Keïta, H.E. President Idriss Déby, H.E. President José Eduardo dos Santos, H.E. President Roch Marc Christian Kaboré, H.E. President Alassane Ouattara, Houlin Zhao and H.E. Dr. Elham M.A. Ibrahim. We acknowledge their pivotal role in offering a new agenda for renewal in dealing with the challenges of urbanization on the African continent. This new agenda founded upon Smart Sustainable Cities gives a realistic opportunity for economic progress, technological advancement, and inclusive growth in African cities.

Dr. Hamadoun Toure, Executive Director of Smart Africa

EXECUTIVE SUMMARY

The United Nations World Cities Report published in May 2016 noted a global trend in which cities have become central to the transformation of the global economy[1]. Urbanization has dramatically changed energy consumption patterns, water and sanitation needs, food security and mobility of human beings. And with this change, there are unprecedented challenges arising from the inability of governments to cater to the demands of urban settlers. Nowhere is this gap more evident than in African cities where poverty results in informal settlement patterns, economic inequality, high youth unemployment and environmental degradation.

In response to these challenges an emergent concept envisions smart and sustainable cities that take advantage of ICT to enhance the ability of leaders to make decisions about resource allocation and improve service delivery. Central to this concept are the nuances of the African continent where counterpoints such as high mobile internet penetration on the one hand and high infrastructure deficits exist that provide unique opportunities to advance technology. For instance, using mobile phone sensors and crowdsourced data to collect traffic and security related data is more relevant than building a separate IoT ecosystem.

This document is a blueprint for Smart Sustainable Cities that is aimed at African city leaders and officials. It begins with some key definitions of notions, trends, and drivers of cities both in Africa and around the world. Subsequently, it lays down the principles for Smart Sustainable Cities implementation and how to manage and control these drivers. For instance, it proposes the adoption of a Smart City Platform for command and control of city flows and services. It also positions the use of big data and analytics to drive decision making in management of city infrastructure, flows and services. There are also pointers for different financing models, policies and regulations which should be considered while developing a program for Smart Sustainable Cities. Even more importantly, this document draws best of class practices and lessons from other cities globally that have successfully embarked on the “Smart Sustainable Cities” journey notwithstanding the African continent’s unique context and development aspirations.

This document is developed in conjunction with the Rwandan Smart City Masterplan which offers a localized example of how African countries can make their cities smart, sustainable and resilient.

[1] http://wcr.unhabitat.org/

THE AFRICA URBAN AGENDA

The draft "Africa Urban Agenda" recognizes that with more than 80 per cent of global GDP generated in cities, urbanization, if managed well can contribute to sustainable and inclusive growth. It achieves this by addressing inequalities, increasing productivity, and promoting job creation, social well-being, citizen participation, innovation, and emerging ideas. As such there is a need for a radical change in thinking about the way cities and human settlements are planned, developed, governed, and managed.

The Africa Urban Agenda endorsed by Habitat III held in Quito, Ecuador in October 2016 commits to implementing the appropriate use of new and existing technologies to improve city management. It also aspires to enhance accountability and transparency and the protection of public resources through the implementation of open data standards.

While such a commitment will also need adequate infrastructure to become operational, the science, technology, innovation, and capacity-development agenda encourages an improvement in the business environment to make it more attractive to investments. This is achievable through access to digital governance solutions, as well as transparent and predictable policies and regulations.

To ensure the successful development and implementation of citizen-centric digital era governance that continuously taps into technological innovations, the agenda highlights that "this will require strong political will, collaborative leadership and new institutional frameworks, including a national ICT policy and e-government strategy, as well as strengthening institutions and building the capacities of the public servants besides ensuring universal access to communications and ICT."

Africa's time is now.

As technology drives mobility and connectivity in urbanized societies, African cities continuously seek to establish new infrastructure and city systems that will enable transition, and position them as global leaders and next generation cities.

CHALLENGES OF AFRICAN CITIES

Rapid urbanization

Urbanization in africa is progressing rapidly. The continent's rate of urbanization soared from 15 percent in 1960 to 40 percent in 2010, and is projected to reach 60 percent in 2050. It is expected that urban populations in africa will triple in the next 50 years, transforming the profile of the region which will challenge policy makers to harness the urbanization phenomenon for inclusive growth and development. Within the next few decades, many other african cities—for example, johannesburg, nairobi, dar-es-salaam, khartoum, casablanca, and others—are set to reach the 10 million person threshold. This growth demonstrates a need for better urban management, especially because over 60 percent of urban african residents live in informal settlements.

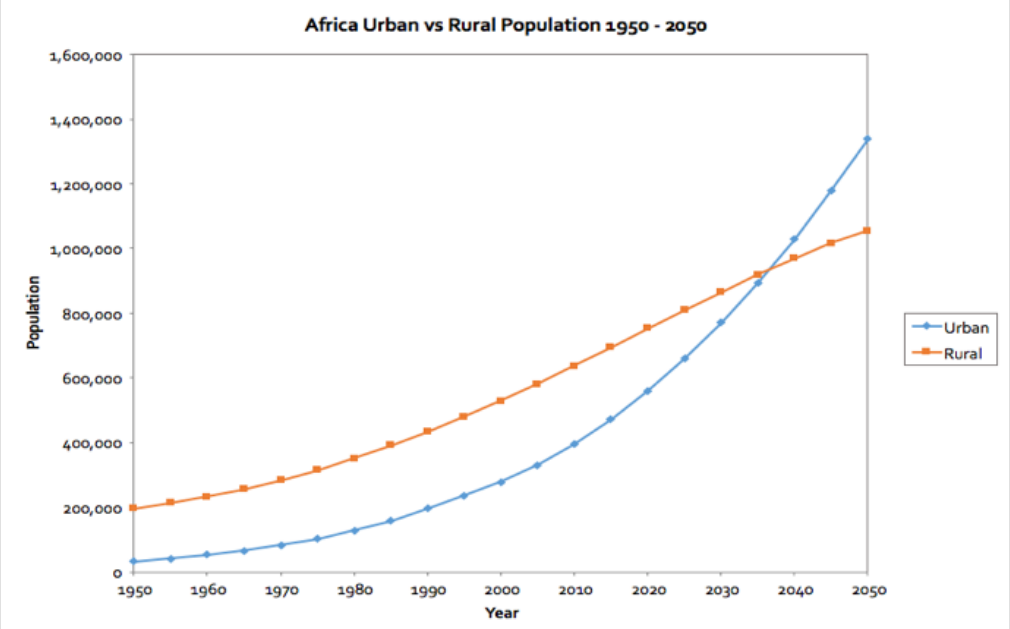

Figure 1. Africa urban and rural populations 1950-2050[2]

[2]http://www.un.org/en/development/desa/population/theme/urbanization/index.shtml

Need for mobility and access to urban service

One of the effects of rapid urbanization is traffic congestion which has an impact on the economy of cities and on accessibility of the community to essential services. For businesses to thrive, goods and services need to flow efficiently. The economic costs associated with traffic congestions in african cities is high: For example, over $500,000 a day in nairobi[3] and up to $8 billion a year in cairo[4].

Increasing power costs and instability of grid

Globally, 75% of the world's energy is consumed in cities. Rapid urbanization increases per capita energy consumption putting pressure on the existing energy systems. Ageing and unreliable utility infrastructure increases the cost of production and distribution of power. Energy is a challenge as it is a vital resource for city dwellers and businesses. Evidently, there is a need for massive investments in generation and transmission.

Access to clean water and sanitation

Both rural and urban Africans have challenges in accessing clean water supply. The WHO stated that, in 2015, 40% of people in sub-Saharan Africa are without access to reliable and improved water sources. Not only is there poor access to potable water, but when water is available in these there are risks of contamination. Only 1 in 3 people in the region have access to proper sanitation facilities[5].

Public health and safety

Security and public safety is a pre-requisite for economic development. Countries should ensure security and safety of their citizens and businesses. With rapid urbanization comes challenges of unemployment, congestion and inevitably rising crime and insecurity. The threat of terror in the region has also increased over the past few years. Cities must therefore invest in improving security, managing epidemics and responding to natural disasters..

Increased capacity

The 21st century calls for new skills and capacity to enable countries, cities and their citizens to compete in the global economic market, as well as utilize and maintain digital transformation - essential for promoting smart cities.

There is a need to improve the relevance of education, equipping students with competences and skills for this transformation, and addressing these future labor market demands and reducing the digital divide. In addition, in most sectors, ICT application is still very low. There is a strong need to improve capacity for research and development to promote a culture of innovation within government and private sector.

THE CONTINENT'S RATE OF URBANIZATION SOARED FROM 15% IN 1960 TO 40% IN 2010, AND IS PROJECTED TO REACH 60% IN 2050.

[3]http://www.bloomberg.com/news/articles/2014-03-25/nairobi-traffic-loses-570-000-a-day-as-no-2-africa-hub
[4]http://www.worldbank.org/en/news/feature/2012/08/21/cairo-traffic-much-more-than-nuisance
[5]http://www.who.int/water_sanitation_health/publications/JMP-2015-keyfacts-en-rev.pdf?ua=1


SCANNING

Smart City

"A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement." Caragliu and Nijkamp 2009[6].

[6]https://www.linkedin.com/pulse/definition-smart-city-confusion-galore-venugopal-ramanathan

WHAT IS A SMART CITY?

Due to the challenges above, as well as the potential of African cities to take the leap towards in the forefront of global digital transformation. An African smart & sustainable city is a city, in which leaders and citizens use data, information and knowledge to ensure a co-created resilient & sustainable future.This will be achieved by:

- Inclusive data-led management & planning
- Efficient community-based infrastructure and services
- Localized and shared innovation and economic development

BENEFITS AND RELEVANCE OF SMART CITIES

Benefits of Smart Cities

Competitive Cities
Cities are competing for global investments and talent. Efficient cities with low bureaucratic barriers attract both global investments and the world class talent. Some cities focus on key industries such as IT to improve competitiveness as a business destination.

Efficient Cities
Cities with limited budgets must be more resourceful. An efficient city provides quality services at a reasonable cost to all city stakeholders and manages its available resources prudently. In addition, a smart city can tap into new revenue streams, by allowing enterprises to leverage the smart city infrastructure for innovation.

Safe Cities
A safe city is a thriving city for residents, tourists, businesses, and communities alike.

Resilient Cities
Cities are under tremendous pressure due to growing populations, undesirable environmental changes, natural catastrophes, and increased security challenges. A smart city is a resilient city which can cope, adapt, and grow.

Shared and Co-created cities
Cities are in great transition from top-bottom to higher involvement of citizens and other stakeholders, including the private sector in all aspects of urban life. Cities that cater for partnerships between the municipality, citizens, and the private sector and for joint responsibility and ownership of assets, resources and community services are more efficient, resilient, and better prepared for real urban growth.

Livable Cities
Livable cities take into consideration the different categories of residents (levels of physical ability, children, elderly, adults, teenagers) when designing the city and its services.

Relevance of Smart Cities

The 17 Sustainable Development Goals (SDG's) adopted by Heads of State and Government and High Representatives in 2015, succeed the Millennium Development Goals (MDG's). They define the new universal development agenda relating to urbanization and rural settlements. Goal 11 calls for countries to "Make cities and human settlements inclusive, safe, resilient and sustainable". Technology making cities smarter can contribute to achieving this goal. Moreover, there is a global focus on making cities sustainable to meet the challenges posed by urbanization. This clarion call makes Smart Cities ever more relevant in now and in the future.

OVERVIEW, SMART SUSTAINABLE CITIES

Half the world's population, 3.5 billion people, live in cities today. It is estimated that by 2030, almost 70% of the world's population will live in urban areas. On top of this 95% of urban expansion in the next decades will take place in the developing world. While the high density of cities can bring efficiency gains and technological innovation, this trend towards rapid urbanization is exerting pressure on fresh water supplies, the environment and infrastructure.

Cities are under tremendous pressure to reinvent themselves. Citizens are placing increasing demand on leaders to innovate, make cities and communities safer, and to offer more economic opportunity. Leaders are operating in environments where budgets are declining, the infrastructure is overstretched, and natural and unnatural disasters pose increasing threats. The world's population is moving into urban areas, placing additional pressure on services. The public has become increasingly connected via social media, and massive amounts of new data are created every day. All of this is compelling leaders to rethink strategic plans and in particular, to figure out ways to continuously innovate to drive sustainability and relevance.

In the face of these challenges and opportunities there is an obvious need to develop a sustainable model to support anticipated growth. Several cities in the world have set aspirations to become 'smarter" and "sustainable" drawing interest from governments, the development community and the private sector. Cities globally are using technology such as sensor networks, intelligent operations dashboards and advanced big data storage and analytics to efficiently manage various city flows that deliver services to citizens such as water and sanitation, energy, and traffic information.

Technology is also being used to enhance the delivery of services such as social welfare, security, rates payments and education. These technology solutions are designed to consider a citizen's data footprint through their lifecycle as they receive services and utilize city infrastructure.

CHARACTERISTICS OF A CITY

The complex and multi-sectoral nature of cities present significant challenges and opportunities. Whereas urban areas play key role in creating prosperity, there is an urgent demand for more integrated planning, robust financial planning, service delivery and strategic policy decisions.

These interventions are necessary if cities are to be sustainable, inclusive and ensure a high quality of life for all. In order to deal with the complexity of urban areas, the optimal use of information available to city managers can help them in:

- Better understanding and management of city operations;
- Optimizing the use of limited resources;
- Balancing social, economic, and environmental needs;
- Measuring (and spurring) progress and outcomes;
- Enabling better experiences, interactions, choices and partnerships between residents, their communities, the business sector and their city.

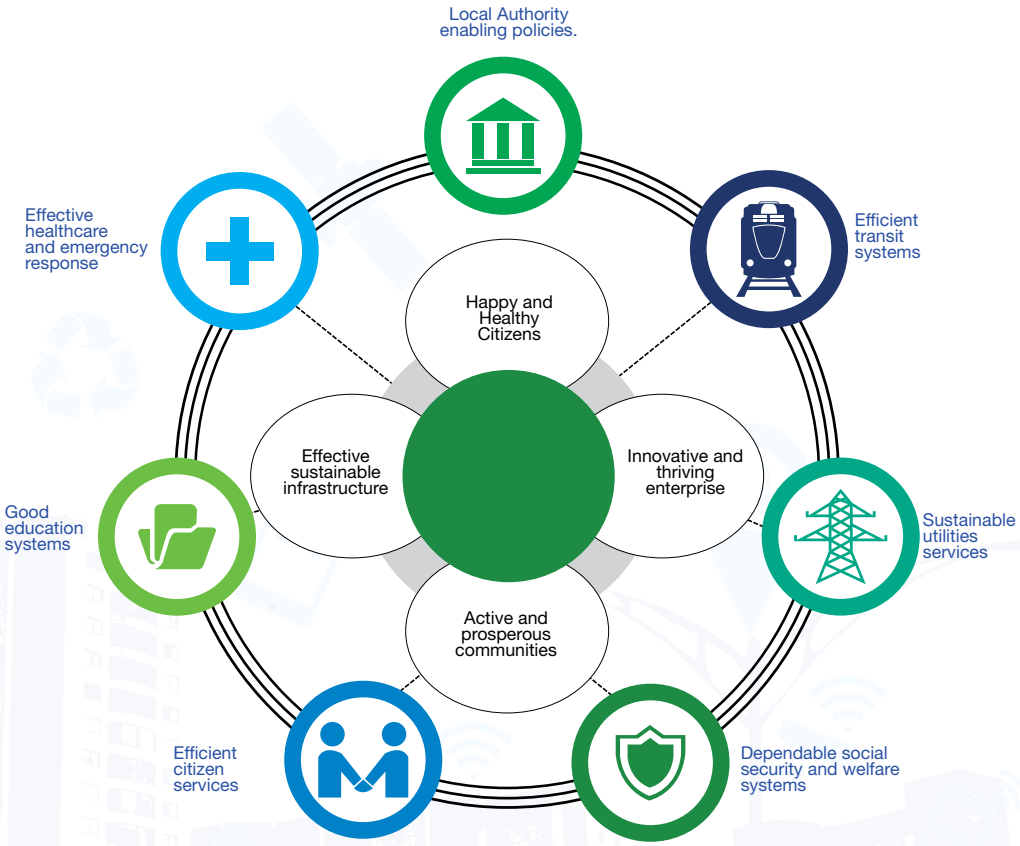

Figure 2. The complexity and integration of urban systems and services

City Flows and City Services

Within a city, there are two major classes of systems that should be considered:

- Flows that run through a city's infrastructure
- Services delivered to people and businesses

City Flows

City flows that run through infrastructure systems, networks and conduits including vehicles, goods and people through transportation infrastructure, information through communication systems, water through supply pipelines, waste through sewerage and municipal waste systems and energy through electricity grids.

Figure 3. City flows (water, air, waste, energy, goods and people)

City Services

A city must also be an attractive place for conducting business as ultimately this will be a key source of jobs and wealth. A smart city requires a smart government, one with economic development policies that attract and retain companies and start new ventures. This requires a well thought out approach to how people or businesses register and use services, from revenue collection, education, and skills development for citizens, to enhancing attractiveness to trade, investment, and innovation.

Figure 4. Citizen services

But in the end, the most asset in a city is its human capital and its ability to attract and retain talented people. Doing so requires attention to several basic human services, like health care and public safety, but also includes a variety of social, community and cultural services that will appeal to those people and families from all over the world that the city wants to attract, both as residents and visitors.

Figure 5. Public health, emergency response and security

City Microcosms - Neighbourhoods, Stadia and Airports

Neighborhoods, stadia, and airports are in fact managed as small cities as they have all the characteristics of a city (in terms of services and ows) such as water supply, electricity, person registration, waste generation and human or motorized traffic. These city microcosms make it easier for cities to rapidly carry out pilots of smart city solution before rolling them out citywide.

This approach of using small clearly demarcated areas in a city for pilot projects is increasingly used in smart city developments globally.

Neighbourhoods

Stadium

Airport

Figure 6. Neighborhoods, stadia, and airports as city microcosms

THE SMART CITY CONCEPT

The Smart Citizen

Today's citizen is empowered through enhanced connectivity via mobile and social platforms to making the invisible visible to city managers. This ability to generate massive amounts of data and give instant feedback on city services and operations has given rise to what is termed the Smart Citizen.

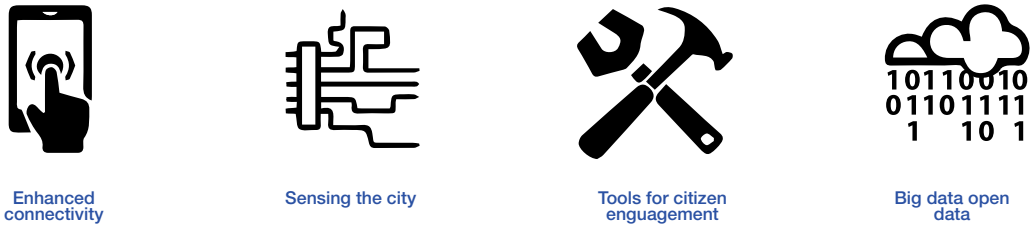

Figure 7. The Smart Citizen is connected, engaged and generates data

The 3 I's of Smart Cities

The global economy and society is moving into an era where the ability to access, analyze and apply insights with speed is driving significant change in both the private and public sectors. To take advantage of this urban areas should be designed with combination of urban sensors and mobile networks to enable collection, aggregation and analysis of data and information, geolocated, presented and integrated via smart management platforms that interconnect city systems to enable smart decision-making based on data analytics.

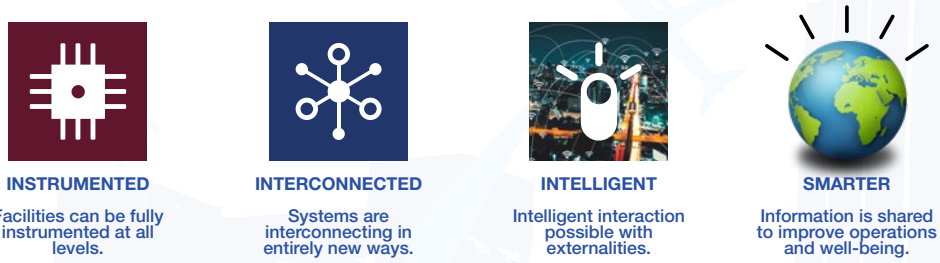

Figure 8. The 3I's of Smart Cities

Gartner describes a "Smart City" as an urbanized area where multiple sectors cooperate to achieve sustainable outcomes through the analysis of contextual real-time information sharing among sector-specific information and operational technology[7].

[7] http://www.gartner.com/newsroom/id/3008917

The 3 R's of Sustainable Cities

While adopting smart initiatives that enhance operation and decision making, cities must make sustainable use of their resources and waste. This can be achieved by embracing the 3R's of sustainability, which are reducing resource usage especially non-renewable energy sources by using green energy sources, recycling municipal waste, and industrial waste, and reusing waste and supplies for alternative purposes.

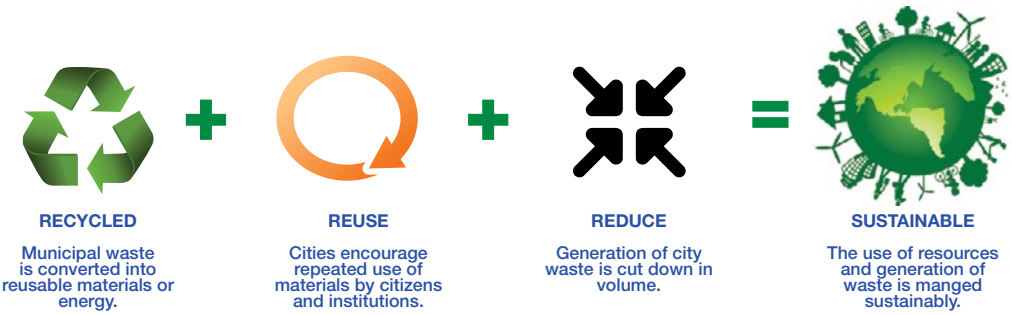

Figure 9. The 3R's of sustainability.

The Smart City Platform

As cities become smarter they can drive sustainable economic growth and prosperity for their citizens. Citizens want to live in cities that have a good quality of life, they want to work in cities where there is economic opportunity, and they want to visit cities that are desirable and safe. City leaders globally are therefore looking to address the following pressing priorities:

"Give me the tools to make better decisions, so that I can utilize the massive amounts of data to derive insights and drive actions."

"Help me anticipate problems, as it is not enough to be reactive. I need to proactively get in front of events and incidents."

"Provide me with capacity to coordinate resources; it's a fact of life, that things happen, and when they do, what tools can I use to coordinate resources/people, processes and systems?"

The Smart Management Processes

To make the most meaningful gains, cities will rely on these essential capabilities that enable the platform to extend across domains.

- **By capitalizing on new insights** through distilling information from the massive quantities and sources of data generated by day-to-day operations, cities can establish holistic, system-wide visibility across domains and approach long-standing challenges in new ways.
- **Develop analytics and predictive capabilities** that pro-actively respond to situations, optimize infrastructure capacity, and improve tactical decision making.
- **By collaborating in new ways** through coordinating across agencies and with citizens and new partners, cities can transform traditional work structures and enable a faster, more effective, and efficient response.
- **Improve communication with citizens** to enhance service delivery.

To achieve these capabilities cities can adopt a citywide vision and process based on studying the city and prioritizing challenges, collecting essential data, choosing initiatives and strategies to address these challenges, and implementing dynamic management platforms, which will assist in coordinating, monitoring and continuously managing including the implementation of essential technology components.

Such platforms may be web-based GIS based solutions, allowing for flexible management, or comprehensive platforms for smarter city management which are managed from a City Command and Control Center, allowing for broad, cross agency management of city issues.

An example of domains and how such a platform can be designed on the right.

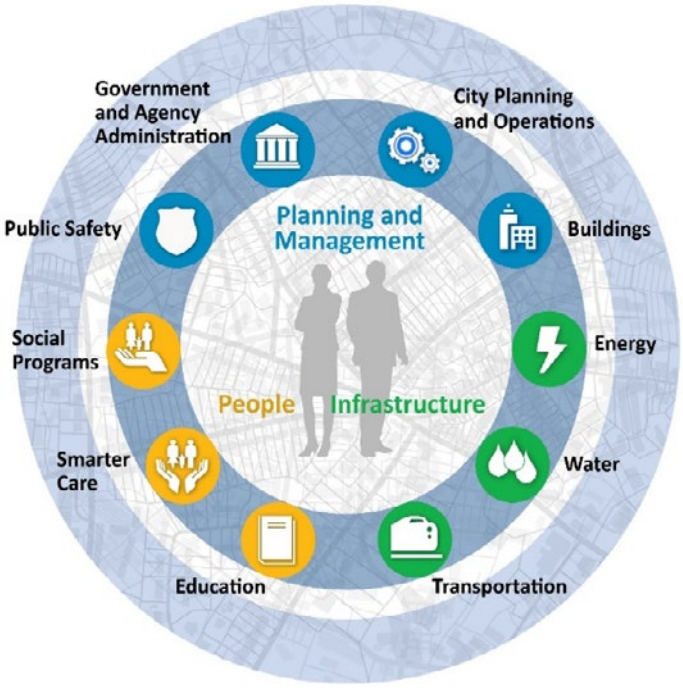

Figure 10. Foundational components of Smart City Management processes

The second more efficient strategy is the horizontal approach. This approach enables the seamless and continuous implementation of different technologies. This platform can initially be focused on a single domain and later extended to other domains for broader, cross agency management of city issues. An example of domains and how the platform can be extended is shown below.

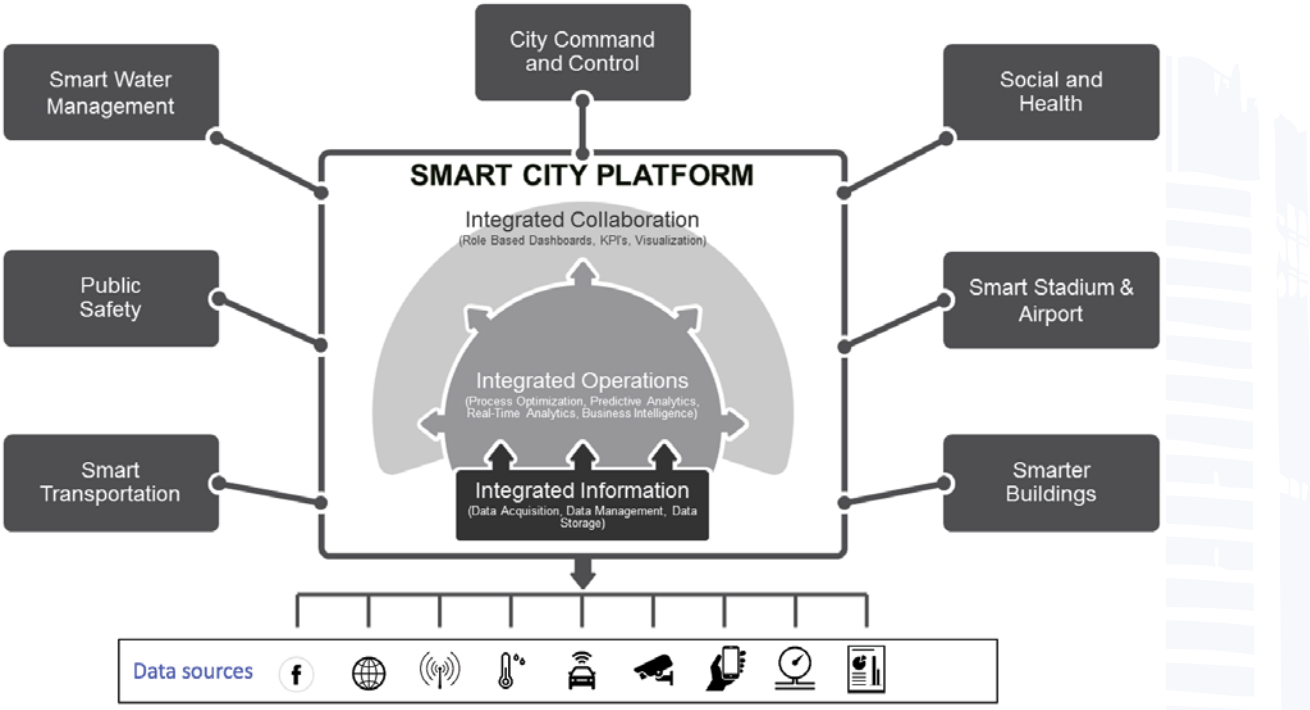

Figure 11. A Smart City Platform

This horizontal approach can solve integration challenges related to the openness of data while ensuring privacy and security. It allows for better integration between the different vertical service areas and ensures cleaner interfaces. This is important to secure interoperability over time, freedom from vendor lock-in, and reduced systems integration costs.

Business Enablers of Smart Cities

- **Bold leadership and governance** is a key element of a successful smart city implementation. There should be either a dedicated entity such as a Smart City office and/or a body such as a Smart City Board consisting of key stakeholders that oversee, manage, and coordinate the development and implementation of this Smart City Framework. The key is that any Smart City plans and initiatives must become an integral part of the city management strategies and structures and there must be buy-in, commitment and ownership from the city leaders.

- **Citizens** are top of mind for city managers around the world. Citizens of cities increasingly expect access to decent and efficient services in education, health, social welfare, mobility, as well as economic opportunities to better themselves. City authorities must respond to these citizen demands.

- **Challenge based Innovation** in order to create a unique and localized economy, solutions and entrepreneurship must address local challenges, through research, design, testing and implementation of solutions, creating feedback from local communities before scaling the tested solutions.

- **Cross agency collaboration** is a focus area for government leaders. By coordinating across agencies and collaborating with citizens, cities can transform traditional work structures to promote innovation.

- **Broad ecosystems** should be developed by creating partnerships between government agencies, the private sector, non-governmental organizations, and academia. City leaders should explore public-private partnerships and other creative approaches to fund and incubate smart city projects.

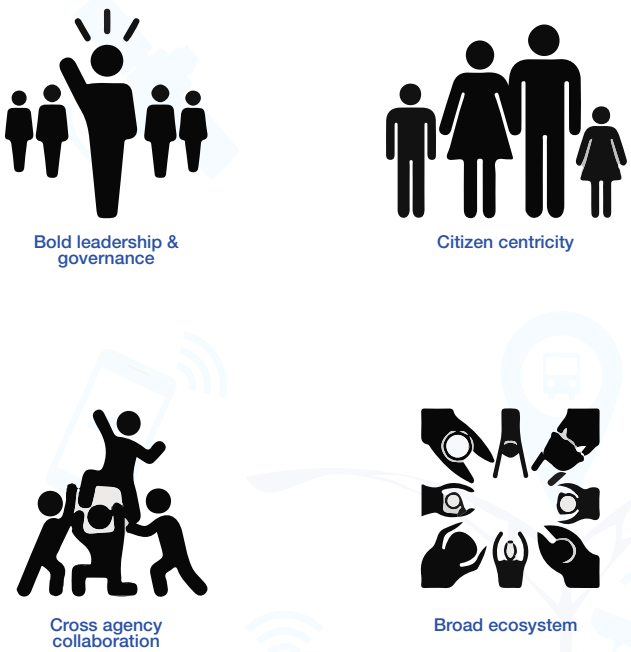

Figure 12. Business enablers of Smart Cities

Technology Enablers of Smart Cities

- **Big data and predictive analytics** are the essence of the smarter city. By integrating massive volumes of data and identifying retrospective, realtime and predictive insights, cities can dramatically improve situational awareness and decision-making in all areas, from emergency response and municipal planning to transportation and education.

- **Social media** allows a boundless, continuous conversation that provides leaders, citizens and private organizations with crucial data and insights about the life of the city. Whether improving communication within city hall or engaging citizens directly to evaluate quality of life indicators, social media can capitalize on the unique interconnectedness of the city landscape.

- **Mobile Broadband** is moving beyond the device to embody the full potential of connected devices. From keeping first responders connected in a crisis to helping drivers avoid a sudden traffic jam, mobile is empowering city leaders and citizens alike with crucial real-time insights. We live in an increasingly connected world where wired and wireless networks provide us with the ability to connect people and devices and to collect and share data and information. Broadband networks in a city should include high speed Internet through fiber or wireless networks for home, commercial and public use.

- **Cloud** is a powerful engine for advancing the way cities pay for IT, store big data and in helping them reimagine operations and service delivery in support of initiatives ranging from smart utility networks to more accessible educational resources.

- **Internet of Things** refers to everyday things being connected to sensors and actuators that enable sensing, communication, and data capture. IoT is a key driver in the way cities operate. From monitoring, smart lighting or monetizing street parking to citywide ICT based public planning and administration.

Figure 13. Technology enablers of Smart Cities

THE SMART CITY DOMAINS

Information Technology (IT) is changing the way cities evolve. The notion of "growing" cities based on implementing correct urban planning is being replaced with the idea of making a city "smart". This section explores how city flows are managed intelligently and services are efficiently delivered to inhabitants.. These dimensions are:

- Smart delivery of city services
- Smart management of city flows

City flows run through infrastructure systems, networks and conduits andinclude: vehicles, goods, and people through transportation infrastructure; information through communication systems; water through supply pipelines; waste through sewerage and municipal waste systems, and energy through electricity grids.

Smart management of city services and flows make for a vibrant economy, effective governance, a clean environment, the sustainable use of resources and the efficient movement goods, services, and people through the city.

Within these management dimensions, there are several individual domains that should be considered.

Smart Delivery of City Services

Smart delivery of city services considers the ability of government institutions to serve citizens, visitors, businesses, and another enterprises resident in a city. For smart delivery of city services, the interaction of a citizen or business with a city government entity during a service request, payment (of taxes, levies, or fees) or when receiving the service, should be accessible, transparent, and efficient. City services include efficient registration services, healthcare services, public health management, welfare and social services, emergency and incident response, and education.

City Flows and City Services

Citizens are the defining unit of a city's citizen registration system as they interact with government during various life events such as birth, marriage, graduation, employment, home ownership, hospitalization, ageing and eventual demise. All personal registration data will be centrally managed using a single identity across a centralized platform to ensure the symmetry of information about the citizen.

Family centered social services that consider the individual, as the unit of the family will be deployed to ensure social cohesion, productivity, and support.

On the front-end, online and one-stop-shop services will enhance the citizen experience for processing life events and access to social and welfare services. This involves raising awareness of potential advantages of smart city services and creating incentives for continuous engagement and use of smart citizen services. It is also crucial to build digital literacy, reduce the digital divide and ensure that smart city services also reach groups experiencing social exclusion. Ensure the co-creation, co-design and co-production of city services by citizens themselves.

Smart Business Services

Enhancing a business environment to make it attractive to investors is central to this dimension. World Bank Ease of Doing business index (that assesses business climate attractiveness in global capitals by looking at the life cycle of business from start-up to closure) should be used both at national and subnational level. This index uses 10 indicators that examine processes, cost and time associated with business start-up, credit and equity financing, daily operations and the legal framework for closure or recovery. Online services for payment and transaction and one-stop-shop government service centers should be expanded to enable ease of transaction for business related services[8].

Smart Healthcare and Public Health Management

Smart Healthcare focuses on enabling healthcare workers such as doctors, clinicians, and nurses to use ICT to increase their ability to diagnose and treat diseases, provide preventive care, and reduce the costs of healthcare for the city. Primary care givers can use cognitive healthcare systems and electronic diagnostic tools to enhance their ability to improve clinical performance and service.

Healthcare facilities can be equipped with electronic medical records that allows patients to be managed using their smart health insurance cards. This will enable the capture, storage, and analysis of critical clinical and patient information. Healthcare facilities will have better medical record management, health insurance claim management, enhanced communication between medical staff and patients, prescription management and drug supply management. Smart Public Health should also focus on combining structured, traditional health information systems data with unstructured community data to improve planning, surveillance and response to disease outbreaks and epidemics.

[8]http://www.doingbusiness.org/

Smart Public Safety and Emergency Response

Security and public safety is a pre-requisite for economic development. Rapid urbanization, poverty, and unemployment result in rising crime and insecurity in cities. Leveraging Smart Public Safety and Emergency Response platforms will help to improve security incident management by predicting, detecting, and responding to incidents such as crimes, accidents, and fires.

These platforms enable first responders to have a tactical advantage by taking a bird's eye view of the perimeter of an incident through GPS capabilities and video surveillance.

Furthermore, first responders can manage risks and optimize resources based on pre-emptive risk profiling, identification of hazards and the assessment of threat levels. Smart Public Safety and Emergency Response platforms will also rely on crowdsourcing through social media to gather and disseminate information about incidents.

Smart Education

Some cities are already implementing the one-laptop per child and smart class room program, which puts connected devices and personalized learning within reach of students and teachers. Smart Education will complement traditional board and chalk method by using mobile devices to deliver academic content to students. In other words, there should be content, computers, and connectivity. Smart Learning Management systems will enable teachers to personalize content individual students but also enable them to continuously review performance and deliver assessment. This will enhance learning outcomes. Accompanied by policies enhancing people's digital literacy and incentivizing the use of these technologies. Multi-level training in coding, programming, data science and web design should be encouraged at secondary school and higher education level.

At a regional and district level a digital schools-reporting platform allows education officials to track performance indicators such as attendance of teachers and students, availability of teaching resources such as books and other factors that affect student performance like weather and sanitation. This enables educators and education officials to understand how to proactively improve learning conditions within their jurisdictions.

Smart City Finances

Financial services include technology that facilitates the exchange and monetization of services and products within the city. Examples include city discount cards, multimodal transport payment solutions, mobile or electronic commerce (e-wallet) solutions for parking and online rates payment and solutions to secure merchant tax compliance.and solutions to secure merchant tax compliance.

Smart Management of City Flows

Smart management of city flows considers the ability of city authorities to use interconnected devices, sensors networks and data to effectively regulate the quality and quantity of city flows.

Smart Transportation and Mobility

To get the benefits of Smart Transportation and Mobility requires CCTV networks in addition to analytics software to monitor and predict traffic flow. Mobile solutions can be used to disseminate traffic updates and enforce traffic rules through an integrated system that would link to the transport operations center.

The "Living Roads Framework" uses road sensors mounted on mass transit vehicles and government fleets (such as police cars, city waste trucks and public institution fleets). This is used to map and identify hotspots by analyzing driver behavior which can be used to prioritize road maintenance.

Over time the public transportation network should develop scheduled and cashless mass transit systems like high capacity buses on dedicated lanes and metro trains. Ride share services and apps can be encouraged to lower the cost of taxi services and the use of private vehicles. Mobile apps that enable automated parking and payment can also be deployed to enhance revenue collection and enable drivers to find parking quickly. Additionally, a smart and enabled driver's license that uses a point system to monitor traffic offenses and enable spot fines can be implemented..

Smart Water and Wastewater Management

Smarter water and waste water management data gathered from sensor networks in the water supply grid will help water utilities manage water pressure, detect leaks, reduce water consumption, mitigate sewer overflow, and analyze water quality. This will enable better management of water infrastructure, assets, and operations.

Integrated water management platforms will give water managers enhanced visibility of water supply and infrastructure. Smart water platforms will take advantage of advanced data management, visualization, correlation, and collaboration technologies to guide executive and operational decisionmaking.

Smart Energy Grids and Buildings

Power utilities implement smart grids by managing the power supply through their infrastructure. Prepaid metering solutions enable consumers to manage their energy use. Smart energy grids can use the power of mobile phones as distributed sensors for outage detection.

Power utilities can achieve efficient connection for new customers by mapping the national grid in a GIS system to enable remote design and network monitoring. Network reliability and an efficient connection processes can be monitored using the Getting Electricity measure in the World Bank Doing Business methodology[9]. Energy generation can be diversified to include a mix of micro grid solutions and green energy sources such as geothermal, solar and wind Smart Building requires commercial and public buildings to use green energy and to be LEED certified. This will reduce energy consumption, and lower maintenance costs.

Smart Air Quality Management

Air pollution from vehicles and industry has a negative effect on human health. In urban settings there are an increasing number of sources of air pollution that must be managed. Smart Air Quality Management s climate models, air quality sensors and computing to predict levels of air pollution. An integrated dashboard can create visual maps showing the source and dispersion of pollutants to pinpoint the type, source, and level of emissions to facilitate the control of air quality.

[9] http://www.doingbusiness.org/Methodology/Getting-Electricity

SMART SUSTAINABLE CITIES ICT ARCHITECTURE

Technology plays a vital role in the development of Smart Sustainable Cities.This can range from expensive platforms like advanced city command and control centers that integrate, visualize, and analyze disparate data sources or devices such as IoT networks consisting of low cost sensors and actuators.They also include technology enablers such as big data analytics platforms, cloud storage infrastructure and mobile networks. Cities may explore flexible and varied solutions, ranging from using existing systems such as GIS solutions and mobile-based software to manage and coordinate these processes, or to opt for a highly-technological architecture, mainly suited for larger cities is explained, the diagram below depicts a blueprint of a Smart City Architecture.

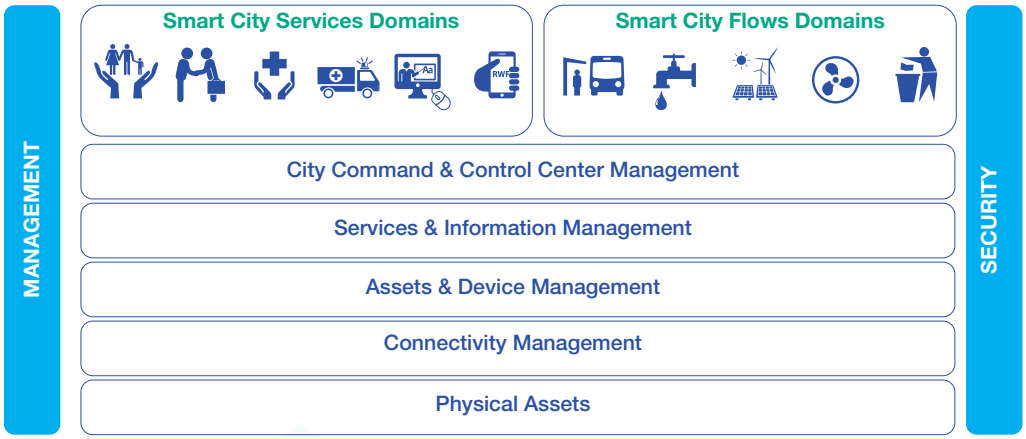

Figure 12: Horizontal stack for a smart sustainable city

Physical Asset Layer

From an enterprise architecture point of view smart ICT infrastructure allows physical assets to be monitored and controlled.

Connectivity Management Layer

This is where connectivity between servers, sensors and the end user receiving a service takes place. This includes sensor networks, connected devices through local or wide area networks, wireless public networks, fiber infrastructure and network gateways. Connectivity Management for these protocols is normally implemented as a central solution in the network or sourced as-a-service from network providers.

Asset and Device Management Layer

The main components of this layer include asset management which keeps track of the lifecycle and use of hardware and software; device management and maintenance and resource management which maps resources in the system and manages access to these resources.

Service and Information Management Layer

Some important components for this layer include:

- Data management
- Analytics
- Identity and user management
- Service exposure and API's
- Common applications
- Customer service
- Revenue management

Data management allows the safe and secure aggregation and retrieval of data. Analytics provides algorithms that analyse structured or unstructured big data from a variety of sources giving real time insight into trends and risks. Identity and user management provide unique profiles to prevent unauthorized access. Service exposure and API's allow third parties to access city infrastructure or data to create new services. The customer service functionality monitors the quality of services to citizens and tracks revenue generation whereas revenue management supports rate setting, billing, and collections.

Command and Control Center Management

Functions handled in the command and control/operational center includes a common visualization of the shared data, the handling of incoming event data through various data sources the dispatching of first responders to resolve a verified event, and communication with the various city stakeholders.

Platform Management

Platform management includes back office server or cloud storage infrastructure for applications for different verticals and those running on the City Command Control Centre Furthermore, it incorporates monetization & billing, performance management, administrative portal, developer portal and other features and functionality.

Vertical Application Layer

The vertical application layer focuses on technology components to manage city flows and city services.

Information Security

The information security layer provides infrastructure to protect the integrity of data and sensitive information. This requires that all IT networks, applications, and servers have security components that are up-to-date to order to prevent and detect unauthorized access, hacks, and unethical breaches. Encryption protocols ensure secure storage, processing, and transmission of data.

Additionally, authentication and authorization of personnel controls access to sensitive systems and data.

PLANNING FOR SMART SUSTAINABLE CITIES

10 steps for planning a Smart City

1. Study the city
Create an initial profile of the city, including the unique physical attributes, existing infrastructure, financial, social and environmental advantages, demographic character and existing challenges. Carry out public satisfaction surveys and establish key performance indicators.

2. Create a smart city steering team
This team should consist of the smart city leaders in the local government, chosen public and private champions and other stakeholders from civil society and the private sector - relevant to the challenges identified.

3. Identify the main challenges
Based on the prepared city profile and through stakeholder engagement, identify the main challenges facing the city. Once identified, prioritize them. What can be solved easily and locally? What needs to be fixed first?

4. Collect data
Once you have identified the main challenges, collect more data to develop better understanding of how to tackle them. Investigate their impact on the financial, social and environmental aspects of the city. Figure out where in the city the challenges are the greatest. Assess who in the city are being most affected.

5. Create a strategic action plan
In collaboration with citizens, and based on the smart city vision, create a strategic action plan. The action plan should contain goals, indicators, initiatives, priorities and clearly identify the internal and external stakeholders that will be affected or need to be included in the planning. The action plan should identify communities and sites for pilot projects.

6. Build a dynamic urban management map
Use the data gathered from the primary study and the challenge process to build a dynamic, GIS-based, map of the city (can be done via a smart city platform as shown above). The map will include 'hotspots' where the challenges are the greatest and goals and targets related to each challenge. The map should include tools that enable digital analysis and be accessible to a wide variety of stakeholders.

7. Implement pilot projects
Based on the strategic action plan, test tools, processes and new technologies through a series of pilot projects. The pilot projects should include trials of similar solutions and evaluations made based on quantitative and qualitative indicators. Also evaluate necessary spatial and financial enabling frameworks.

8. Monitor and evaluate the pilot projects
Evaluate the success of the pilot projects and proposed technological solutions in meeting the challenges. Collect feedback from citizens and local stakeholders, as well as through sensors and big data when and where needed. Valuate and analyze the preliminary success, and based on this data, consider direct and indirect effects of the solutions and decide to continue, adjust or abandon the initiative, while examining the relevance for use in other locations within the city, and elsewhere based on local culture, costs or other effects. Based on the evaluation the projects can be scaled.

9. Provide capacity building of stakeholders
Provide education and training to government officials, citizens and partner organizations. Ensure everyone has the skills to understand, use and implement the initiatives effectively, while being able to provide useful feedback regarding the quality and relevance of the solutions or some components.

10. Apply dynamic management and coordination processes
Evaluate success or failure through continuous monitoring and stakeholder feedback. Make regular changes. Alter, replace or prioritize initiatives through regular evaluations and validations of the action plan. Promote PPP initiatives based on real-time opportunities and update the vision based on political changes or shifts in needs or budgetary situations.

POLICY AND GOVERNANCE

Smart Sustainable Cities are about creating a synergy between technology, infrastructure, policy, and strategic planning. They are also about the relevant policies and ecosystems that make a city habitable for all citizens. Here is a set of policies issues which cities should be aware of while planning for smart cities:

- **Utilities:** Cities should create policy around energy, gas, water, waste such as: Consider whether a household can generate electricity and feed this into a smart grid or not? Waste separation? Stepped pricing of water to discourage water misuse during a crisis.

- **Infrastructure:** Cities have an infrastructure policy which can include buildings, parks, and playgrounds. The policy should address issues such as building or the percentage of open space for every built up area etc. How can parking be monetized? Who takes the ownership of different infrastructure?

- **IT Security and Privacy:** To protect the privacy of users, cities must have a privacy policy. All data should be secured and masked to protect citizen from any harm. At the same time, cities should embrace open data frameworks and collaborative innovation without compromising on security and data privacy.

- **Citizen:** Cities should think of all the people who either live or come to city for any reason. Policy around safety, ease of movement and right to access the services of cities should be developed. Policy around all types of people including the elderly, the poor and the young should be considered.

- **Public administration:** Access to national and local government services should be open to all citizens. The policy around ease of use and access of services should be properly structured. Policy can set certain guidelines but weak governance means policy implementation will be weak. Cities should therefore have a good governance structure and clear policy. Policy should be updated continuously according to the changing needs of the stakeholders.

FINANCING OPTIONS FOR SMART SUSTAINABLE CITIES

Developing a smart city requires long-term infrastructure investment. This costs money and it is unlikely that city governments will have the resources to fund and run smart city deployments independently. Furthermore, different stages of smart cities deployments require different types of funding. In the beginning cities may obtain specifically earmarked grants or appropriate their own budget to do research and development with academic institutions. Once there is a proof of concept, aggressive fundraising through commercial or public private partnership ventures may be used to raise finance. For the large capital expenditure needed to progress through implementation successfully. Several financing mechanisms can be adopted including:

Traditional Options for Financing

Equity Financing

- **Direct Financing.** One way cities can generate fund is by issuing securities in return for cash.
- **Indirect Financing.** If a city cannot access security markets directly it can instead approach financial institutions to raise capital.

Senior Debt Instruments

- **Secured debt.** The borrower pledges assets as collateral.
- **Non-Secured debt.** This is used if the borrower does not have appropriate assets to offer as collateral. This type of financing is usually expensive and attracts higher interest rates.

Subordinated Debt and Mezzanine Financing

- **Subordinate debt** sits in mid-way between equity and senior debt instruments in terms of risk.
- **Mezzanine debt** financing is a mix of both equity and senior debt instruments.

Public Financing

- **Grants** are a traditional form of funding which normally do not require repayment.
- **Interest subsidies** are offered by government institutions to cities with extended payback period, low interest rates, payback grace period and short term interest deferrals.
- **Revolving funds** are loans that can be repaid with revenue earned. It is important when liquidity is scarce.

Non-Traditional Options for Financing

- **Smart bonds** – these are real purpose bonds. That means that the return is guaranteed after the implementation of the project.
- **Spread shareholding** is where investors do not buy a bond but a share in the infrastructure. This type of investment has higher risk but the upside potential for profit is also high.
- **Crowd financing** takes advantage of collective efforts of individuals to raise funds.
- **Public private partnership (PPP)** is an instrument in which public sector institutions and private firms co-invest in the development of public infrastructure. Private companies seek ways to advance their own business interests at the same time realizing a public good based on a common challenge. These arrangements can be based on revenue sharing business models after implementation.

CONCLUSION

The development of a Smart City is a collaborative journey between the public sector, private corporations, development partners and citizens. It is incumbent on city leaders to orchestrate and drive the implementation of a smart cities initiatives. While there are examples of the private sector and development community initiating certain aspects of a smart cities program such as ride sharing apps, e-health applications and mobile payment platforms, the potential to scale and broaden the impact of these initiatives can only be realized when city leaders own the implementation of a smart cities program.

Africa is the next frontier for innovation in the smart cities arena. There are already many examples of successful initiatives in Africa ranging from eParking solutions in Nairobi to “irembo” in Rwanda, a one-stop online portal for e-government services.. These initiatives are borne from embracing the very specific challenges, opportunities, and nuances in the African continent. City officials most often manage public utilities and services. Therefore, smart city initiatives that enhance the quality and sustainability of these services using technology must be embraced at public institutional levels. The question African city leaders grapple with is how do they institutionalize these initiatives? This blueprint provides guidance on how to conceptualize, plan, finance and implement smart cities initiatives. Defining your context and discussing a strategy is the first step in this transformational journey.

> This blueprint is a first step towards a structured Smart Sustainable City development in Africa.

APPENDICES

Appendix 1 - Standardization in Smart Cities

In a domain as complex and multi-disciplinary as "Smart Cities", there will be many challenges for standardization. The central role of technology is in defining characteristics of a Smart City will be implemented in accordance with sustainable development and resilience of communities, as defined in ISO/TC 268." [Source: ISO/TR 37150:2014, 1]. There will also be many standardization requirements for Smart Cities that go beyond ICT.

- **ITU-T SG20:** IoT and its applications including smart cities and communities (SC&C)
- **ISO/IEC JTC 1:** Identify the ICT-specific standardization requirements based on an understanding of the needs of Smart Cities.
- **ISO 37120** Sustainable development and resilience of communities - Indicators for city services and quality of life.
- **ISO/TR 37150:** Smart community infrastructures - Review of existing activities relevant to metrics.
- **ISO 37101** Sustainable development and resilience of communities - Management systems - General principles and requirements.
- **ISO 37102** Sustainable development and resilience of communities - Vocabulary.
- **ISO/TR 37121** Inventory and review of existing indicators on sustainable development and resilience in cities.
- **ISO/TS 37151** Smart community infrastructure metrics - General principles and requirements.
- **ISO/TR 37152** Smart community infrastructures - Common framework for development and operation.

Several more standards from ISO and other standards making bodies such JTC, IEEE, ITU and IEC can be referenced from ISO[10].

Appendix 2 - Smart City Initiatives in Rwanda

Rwanda has already embarked on initiatives to transform its cities and make them smart. Rwanda has developed a smart cities masterplan to translate this blueprint into an operational plan to encourage other member states of Smart Africa.

The Smart Kigali Initiative aimed at modernizing citizenship through use of ICT for better service delivery. The initiative is aimed at providing free broadband Wi-Fi Internet access in public places that include commercial buildings, bus stations, airport, public transport and cabs; Improving Internet connectivity and access in hotels and restaurants; establishing online automated navigation system for direction using the newly implemented street and home addressing information system; introducing automated ticketing and taxi meters in public transport; and electronic payments systems to improve financial services.

Irembo eGovernment Portal

Government has set up a one-stop online portal for e-government services named "Irembo". Irembo in Kinyarwanda "means gateway or door and represents literal access." E-services enable citizens to access government services anytime, anywhere via an Internet connection. One of the services is, for example, construction permits can be applied for and accessed online, thus increasing efficiency and saving costs both for individuals and government.

[10]http://www.iso.org/iso/smart_cities_report-jtc1.pdf

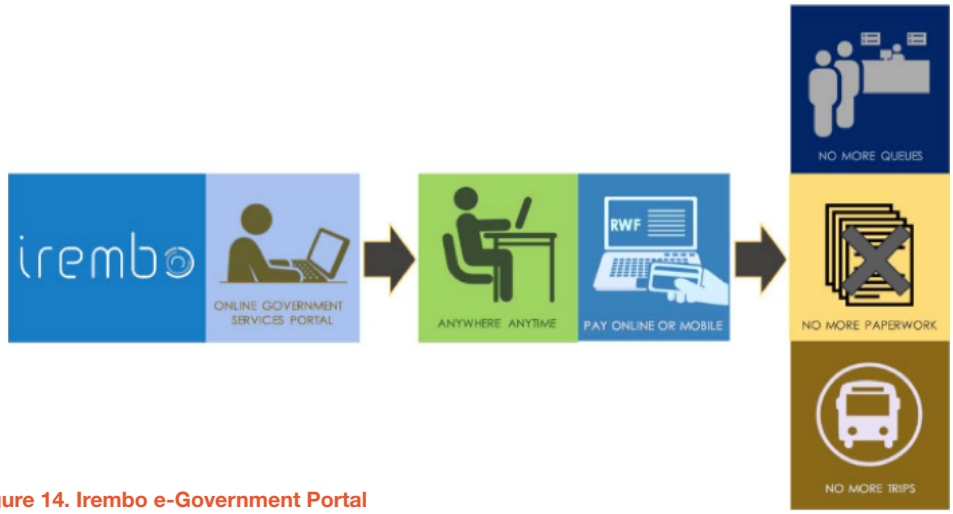

Figure 14. Irembo e-Government Portal

Smart Buses

Buses have been equipped with free Wi-Fi. Passengers on the buses are now able to browse the Internet and stay connected as they commute. Some of the buses have also been equipped with contactless card payment terminals under a system called "Tap-and-Go" created by a local Rwandan company. This innovation contributes to a cashless society that is more efficient.

SafeMotos

SafeMotos is a smartphone application that helps reduce traffic accidents and promote safer travel with motorbike taxis popularly known as motos in Kigali. It does so by connecting their customers to moto drivers who have been vetted using affordable smart phones. The smartphones have sensors in them to detect how the driver drives, and rates them accordingly. Customers can then connect to the safest drivers in their system.

Smart Buildings

The current building code calls for commercial buildings to be smart in the way they manage their resources. In addition, every building should be connected to broadband as well as have fire protections mechanisms with automatic detection sensors, CCTV, and free Wi-Fi.

The Smart Classroom

Rwanda's Vision 2020 is to transform the country from an agrarian society to a knowledge society and this requires imparting students and teachers with 21st century skills. Since 2008, Rwanda has invested significantly in providing ICT to all schools. Recently the Ministry of Education unveiled the Smart Schools Masterplan where every school will receive equipment to make their classrooms smart. The Ministry of Education together with Ministry of Youth and ICT has also enabled all university students to access an affordable laptop through the Viziyo project.

Smart Health

A digital health care system that allows patients to access doctors, clinical records as well as medical prescriptions through their mobile devices has been made available in Rwanda by Babyl. Smartphone owners download an app while those with feature phones access the digital health service through a USSD code. Babyl also plans to provide sexual reproductive health services to young women through this digital platform.

Appendix 3 - Smart City Global Case Studies

Bangalore Water Supply and Sewerage Board – Intelligent Water[11]

Background
The Bangalore Water Supply and Sewerage Board was established in 1964 as a division of the Government of Karnataka responsible for water distribution and sewage management. The company supplies nearly 900 million liters of water daily (MLD) to more than 10 million people who live in the Bangalore metropolitan area. Over the last decade, the population of Bangalore doubled.

This expansion strained the city water board's ability to maintain equitable service. The distribution network lacked instrumentation or any near-real-time visibility into water ow and it relied on manual methods to manage the water supply.

Solution
The board launched a water-management solution that uses advanced analytics and provided near-real-time feedback on water-supply status.

Benefits
Real-time feedback on the status of the water supply, enabled engineers to make timely modifications to the water distribution patterns; reduced energy costs related to water transmission through more effcfient pumping and delivery; and mitigated water loss due to theft, leakage, and malfunctions, potentially conserving as much as 40% of the water supply.

Nagpur Municipal Corporation –Improving water efficiency[12]

Background
In 2005 a water audit by the Nagpur Municipal Corporation recorded water losses at 62%. Energy costs in 2004-05 were 21.1 crore rupees, nearly half of the city's water operation and maintenance budget.

The city had to improve its energy management, both to conserve water and to extend the life of the city's water supply equipment.

Solution
The Nagpur Municipal Corporation initiated a study of its water management infrastructure and found that the efficiency of the pumping system was low and that there was significant potential to increase energy efficiency and decrease operational costs. The audit recommended the establishment of an automated water management system.

Based on this recommendation, the Nagpur Municipal Corporation rationalized water distribution and pumping systems to reduce static and friction. It replaced old, inefficient pumps with energy efficient pumps, improved pump machinery and installed remote monitoring systems to efficiently operate the pumps.

Benefits
The city's strategy led to a 106.96 Kwh per million liters a day (MLD) education in energy consumption. It also helped the city to recover 7 MLD of backwash water and save more than 10 crore rupees in operation and management costs. Pumping efficiency rose from 40% to 75%. The Nagpur Municipal Corporation's experience shows that a structured approach, investment funding, and speedy implementation can help to achieve tangible savings.

[11] http://www03.ibm.com/software/businesscasestudies?synkey=W591880C05007W49
[12] http://www.smartcitieschallenge.in/casestudy/hubli-predicting-water-supply-through-mobile-technology

Stockholm – Sustainable urban mobility[13]

Background
Sweden's capital city Stockholm has been working on climate change mitigation and adaption since the 1990s. The city has well-implemented climate action plans and policies to ensure it meets its ambitious environmental targets. The CO2 emissions have been cut by 25% per citizen since 1990.

The city's climate action group coordinates implementation and monitors results of all climate actions undertaken in the city with a long-term goal of being fossil-fuel free by 2040.

Solutions

The popularity of online shopping has led to more delivery trucks visiting residential areas resulting emissions, noise, and traffic hazards. Smarter, integrated deliveries will cut traffic and provide better information on delivery times. Cleaner vehicles will help to reduce pollution levels.

Congestion in cities is a source of delay and frustration for commuters, as well as damaging air quality. Sensors will monitor traffic patterns, providing citizens with real-time information on travel times and transport alternatives to help cut their commute.

To overcome our reliance on fossil fuels, alternative fuel sources are needed but lack infrastructure. Grow Smarter will invest in charging points and infrastructure to speed up the switch to alternative fuels.

Public transport is great for regular commutes, but what if you want to make a short trip? By testing a combination of bike pools, shuttle services, carsharing schemes and taxi services, Lighthouse Cities will work out how to make these personal trips easier without the need to own a car. There are three Lighthouse Cities: Stockholm, Cologne, and Barcelona. Various smart solutions will be piloted in these cities.

City of Minneapolis – Smart city platform[14]

Background
The City of Minneapolis is home to nearly 400,000 people. Together with its sister city, St. Paul, it is part of one of the largest metropolitan areas in the United States. The area has 3.4 million residents and contributes well over half of the gross state product.

To improve the quality and responsiveness of citizen services, the City of Minneapolis needed to support collaboration and coordination among departments and provide the shared data they should do their jobs.

Solution
A first-of-its-kind central planning tool bridges the gaps between police, regulatory services, and public works departments by combining their data. The solution provides analytical models and geospatial mapping capabilities to support integrated planning, helping the city predict the location and timing of criminal activity, traffic jams and other disruptive events while forecasting the impact of special events, construction, road closures and the weather.

Benefits
With better access to information the City of Minneapolis increases the efficiency and responsiveness of its services, improves public safety and boosts citizen satisfaction. Police officers can complete some investigations faster. The solution also helps the regulatory services department coordinate city events and activities more effectively, reducing the number of scheduling conflicts between, for example, sporting events and street sweeping operations. And the city reduces traffic jams by planning ahead for scheduled construction, road closures and maintenance operations.

[13] http://www.grow-smarter.eu/solutions/sustainable-urban-mobility/#c102
[14] http://www-03.ibm.com/software/businesscasestudies?synkey=H115002W74158O70

Dubai – Smart Dubai roadmap[15]

Summary

The Smart Dubai Roadmap is a set of initiatives and services for city-wide implementation and is considered best practice use of a Smart Sustainable City Roadmap Contributions from other government entities, the private sector and the public will exponentially increase initiatives and services. The initiatives and services, to be delivered until late 2017, will support Dubai's ambition to establish itself as a leading smart city.

Methodology

The roadmap is a dynamic catalogue of all current and planned initiatives and services representing the first phase of contributions from government and private sector entities towards accomplishing the mission of Smart Dubai.

This will be achieved by:

- Identify opportunities
- Assess initiatives and services
- Collaborative roadmap / strategic partners

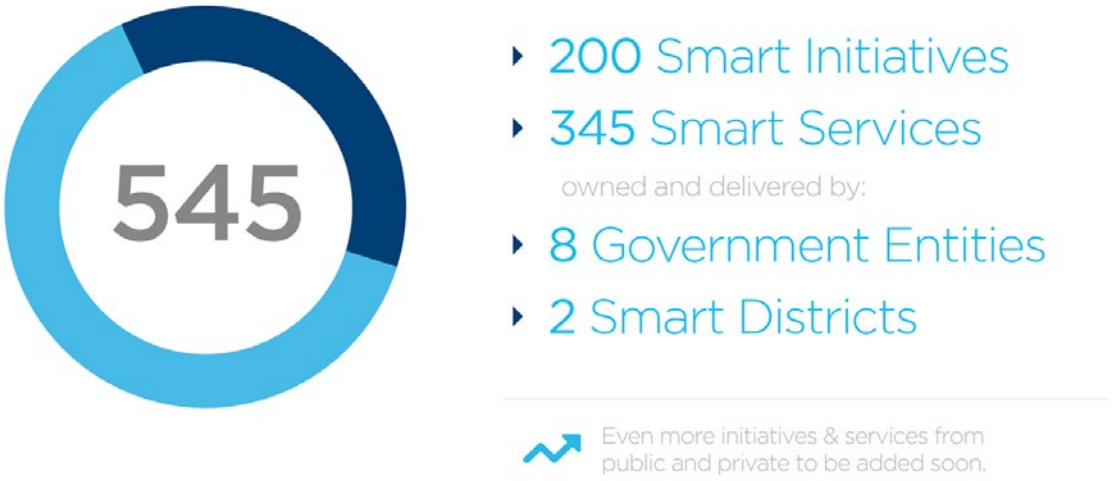

Figure 15. Smart Dubai Roadmap

The Hague- Neighbourhood Participation

In the Vogelwijk neighborhood of Dutch city The Hague, residents have used their own money to restore an existing, inactive windmill and put it back into operation. This mill provides green energy for 450 households. It is an excellent example of neighborhood participation, whereby residents are fully responsible for a sustainable initiative and its execution.

The municipality made a conscious choice not to direct the project. 'But we can support them during the start-up phase of the process', explains vice mayor Baldewsingh (Sustainability and the Environment). This help may take the form of an energy analysis of the home and the preparation of a business case. An important element of this approach is that residents, through a cooperative, may issue shares in the neighborhood. Investing their own money and receiving a share in the profit increases their involvement[16].

[15]http://roadmap.smartdubai.ae/executive-summary.php
[16]http://www.smartcitiesineurope.com/2011/11/the-hague-the-netherlands-neighbourhood-participation/

Rotterdam – Innovative cooling networks

The Municipality of Rotterdam is exploring the possibilities for using water from the river Maas for cooling buildings. They do this in cooperation with the energy supplier Eneco. As per Alexandra van Huffelen, Vice Mayor Sustainability in Rotterdam, three factors are essential for successful public-private partnerships.

- Having a joint objective
- Securing joint financing
- Drawing up a joint implementation program

'If you talk openly and with respect about each other's problems, you create space for finding solutions that may not be all that obvious', says Herman Exalto, Managing Director of Eneco Heat and Cold. For example, by making a few adjustments to the design of a new underground bicycle shed at the Central Station, they could accommodate a part of the cooling network near one of the largest transport hubs in the city. Trust appeared to be one of the key elements.

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