

TOWARDS SMARTER CITIES



TOWARDS SMARTER CITIES INTERNAL WHITE PAPER - V3.0

Prepared by PUD
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shair and partners

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A

OVERVIEW

ABOUT SMART CITY

Urban performance currently depends not only on the city's endowment of hard infrastructure ('physical capital'), but also increasingly so, on the availability and quality of knowledge communication and social infrastructure ('intellectual and social capital'). The latter form of capital is decisive for urban competitiveness.

It is against this background that the concept of the "smart city" has been introduced as a strategic device to encompass modern urban production factors in a common framework and to highlight the growing importance of Information and Communication Technologies (ICTs), social and environmental capital in profiling the competitiveness of cities.

Recently technological milestones have altered the dynamics within our cities so profoundly that some believe the movement rivals the changes brought on by the Industrial Revolution. The evidence for these changes is embedded in our popular culture and the increasing dependency on new technology and digital processes within our daily lives. Technology has the capacity to either exacerbate social fragmentation or to promote and encourage integration, cohesion and sustainability. We wish to follow the latter path.

We therefore believe in technological solutions that not only manage more efficiently city functions and facilities but also act as an empowerment tool improving citizen's ability to live, work and communicate.

Our Definition

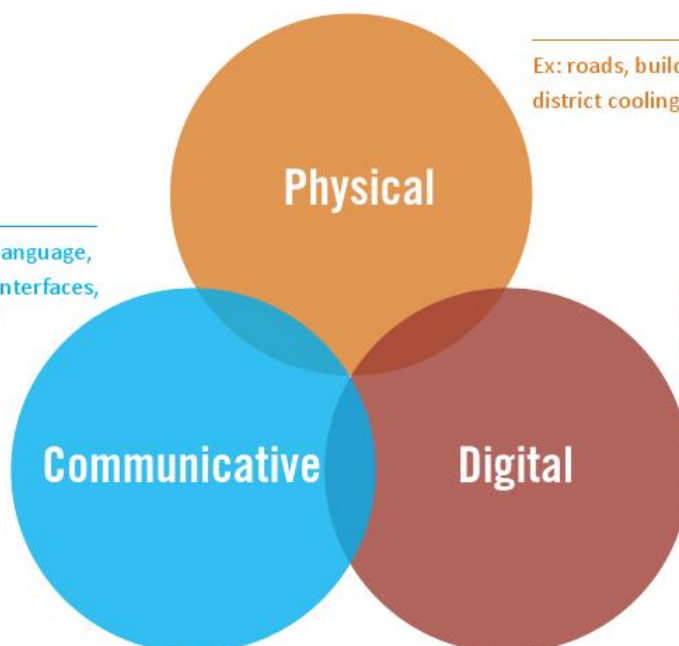
In cities, all individuals, businesses, and activities are interconnected by a multitude of flows of information.

Cities generate a considerable volume of data, still largely untapped in traditional urban planning and management.

Smart Cities make use of ICTs to enhance our understanding of the production of urban data, and exploit it to deliver societal, economic and environmental value.

INTEGRATED INFRASTRUCTURES The road, the sensor and the software

Ex: standardised coding language,
single IP network, open interfaces,
open source technology



Ex: roads, buildings, energy grid,
district cooling, sewage system,...

Ex: broadband, cloud computing,
fibre optic cables, sensors, intelligent
management systems...

DE-MYTHIFYING THE “SMART” LABEL

BEYOND THE TREND OF AN EMERGING CONCEPT

Connected City, Digital Skin, Internet Age, Urban Intelligence... The number of buzzwords recently appearing in urban projects is staggering, but the different meanings they convey crystallise around the concept of Smart City.

Smart City *is* a trend, and it is in the making. This trend, however, corresponds to a reality: the development of new technologies embedded in the urban realm, radically affecting the quality of our lifestyles; the appetite of urban developers and decision-makers embed cutting-edge technology in their projects.

Smart City is not the new name of the Sustainable City: it is a self-standing concept that, although integrating sustainability demands within its design, is first and foremost centred on technology within the city.

Considering the growing eagerness of project commissioners to include a Smart City component, the current fuzziness of the concept can be used to a first-mover's advantage: the challenge is to shape a new facet of it, the opportunity is to benefit from the premium by creating a new market segment.

**“Smart” is the new “Green”
but Smart is not Green**

THE FOCUS OF SEMINAL ACADEMIC WORK

If Smart City appears fuzzy, it is because a great number of companies have produced material detailing their vision for their own “smart city” project.

However, Smart City is not just about brand promotion and marketing: it has been addressed by academia to attempt to rationalise it.

Komninos defines it as “territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management” (2002).

This definition however allows for some level of variation, which led to some scholars, such as Holland (2008) to express concern: given the variety of so-called Smart City initiatives in scope, objectives and technologies involved, the concept appeared to be used merely as a label oriented towards business development of cities, with no firmly set content.

The question of the definition of the content of Smart City remains essential, and reveals the scope for initiative by new players moving into this field widely led by the urban practice.

Two streams of research emerge at this stage of the evolution of the Smart City concept: research focused on the technology developments associated with Smart Cities (what technologies, how to embed them?), and research focusing on the political and social consequences of Smart City initiatives. Both are relevant to Dar's practice, at two different time-scales: short term and long term.

A VARIETY OF ACTORS HAVE TAKEN A STANCE ON THE MATTER

Has Smart City been put on the agenda by technological leaders such as Cisco and IBM? They provide integrated software solutions based on hardware innovations embedded in the city, and their offers seem to have slightly anticipated the demand for such projects.

At any rate, the widespread use of the concept of Smart City by institutional actors certifies the momentum it has benefited from. The EU has made a number of moves in this field, notably through an annual Smart Cities Stakeholder Platform Conference, that influences the content of the Europe 2020 objectives. This is one of the many examples of institutional uses of the concept in public policy strategies, especially legible at the city level.

CONSULTANCIES ENTER THE FIELD - WHAT POSITIONING FOR DAR?

An unanswered question remains regarding the position that urban consultancies should adopt in the light of these new developments. In a new market with promising perspectives, large consultancies such as Arup and HOK are yet to find a stable mode of collaboration with public actors and “information architects”.

In this sense, Dar can devise a unique strategy that fits best its interests and maximises the value that “Smart City” can bring to its projects. Given its existing relations with public actors in a number of geographical areas, and its strong engineering base, the implementation of a Smart City strategy that builds on current assets can prove very beneficial.

OPPORTUNITIES



COLLECT data
COORDINATE resources
ANTICIPATE problems
SHARE with city users

"Infrastructure plays a fundamental role in development, whether it's a business, a city or a society. If customers do not use utilities smartly, then power will be wasted. So we need to make utilities smart and make the grid smart"

HE Saeed Mohammed Al Tayer, Managing Director and CEO of DEWA

COLLECTING DATA TO MAKE BETTER DECISIONS

Our cities are awash in data. It comes from buses and trains, water pipes and gas lines, hospitals and buildings. Smart Cities collect and analyse this information in real time.

Using appropriate analytical software, data can make it easier to understand and act at every level of the cities operating systems. The aim is to give the right information to the right people at the right time, to inform the decision-making process and efficiently measure impacts.

COORDINATING RESOURCES FOR AN EFFICIENT CITY

Analytics can help city agencies prepare for these situations, coordinate and manage response efforts and enhance the on-going efficiency of overall city operations. By sharing information across agencies, such as metrics, events and processes, and by collaborating in real time, cities can better anticipate and respond to their challenges while optimising the use of resources.

ANTICIPATING PROBLEMS

Advanced analytics solutions are cost-effective tools to help city leaders discover patterns and trends in structured or unstructured data. Analytics help government agencies and departments to unite data silos and provide a broad-based access to consistent information.

By applying performance and predictive analytics to this trusted data foundation, departments can make better decisions and even anticipate the results of their in a wide range of areas, from fund allocation to patrol cars deployment.

SHARE DATA WITH CITY USERS, BUSINESSES & SERVICE PROVIDERS

Sharing data - or open data - is perhaps one of the most promising aspect of smart cities to foster innovation and added value by creating new business opportunities and services. The open data policy of most Smart City initiatives enables end-users to actively participate in the system. It is a self-adaptive system, a key success factor in fast-evolving urban environments.

**“ICT-enabled energy efficiency
€600 billion could translate into
over worth of cost-savings
for the public and private sector”**

source: IBM “How Smart is your city?”

**15% of emissions can be saved in 2020
through ICT-enabled energy efficiency**

source: IBM “How Smart is your city?”

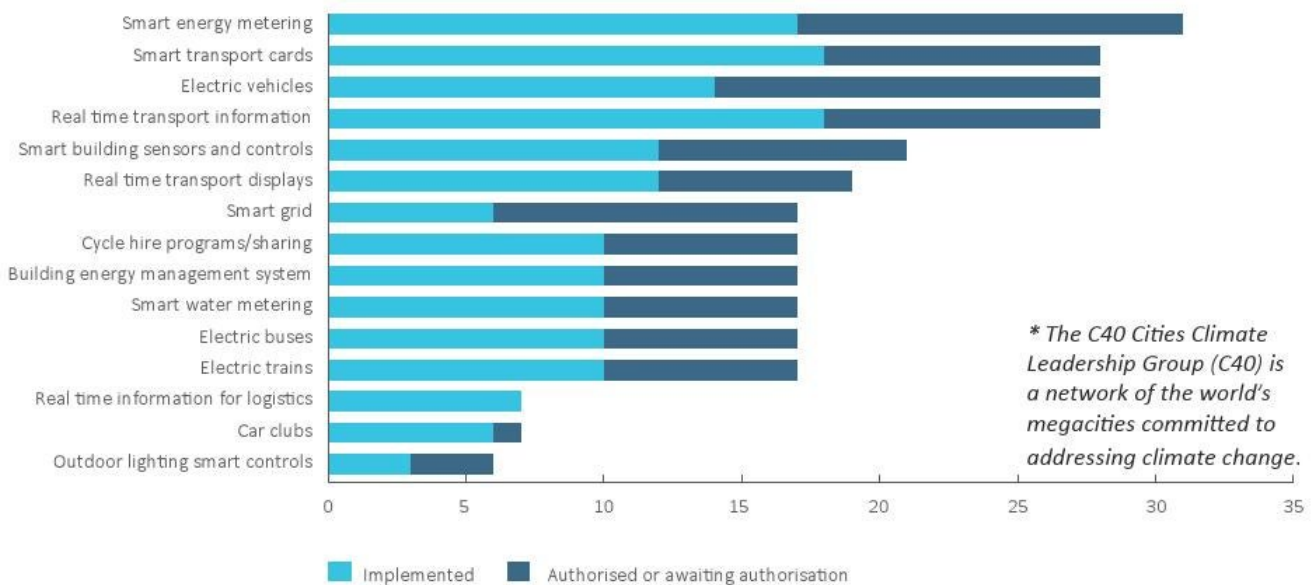
**“Access to public data
is estimated to be worth
€27billion in the EU only”**

source: IBM “How Smart is your city?”

**“the value of the smart cities market is estimated at
\$526.3 billion, with a compound annual growth rate
of about 14.2% from 2011-2016”**

source: IBM “How Smart is your city?”

Smart City solutions in 36 member cities of the C40 network *



** The C40 Cities Climate Leadership Group (C40) is a network of the world's megacities committed to addressing climate change.*

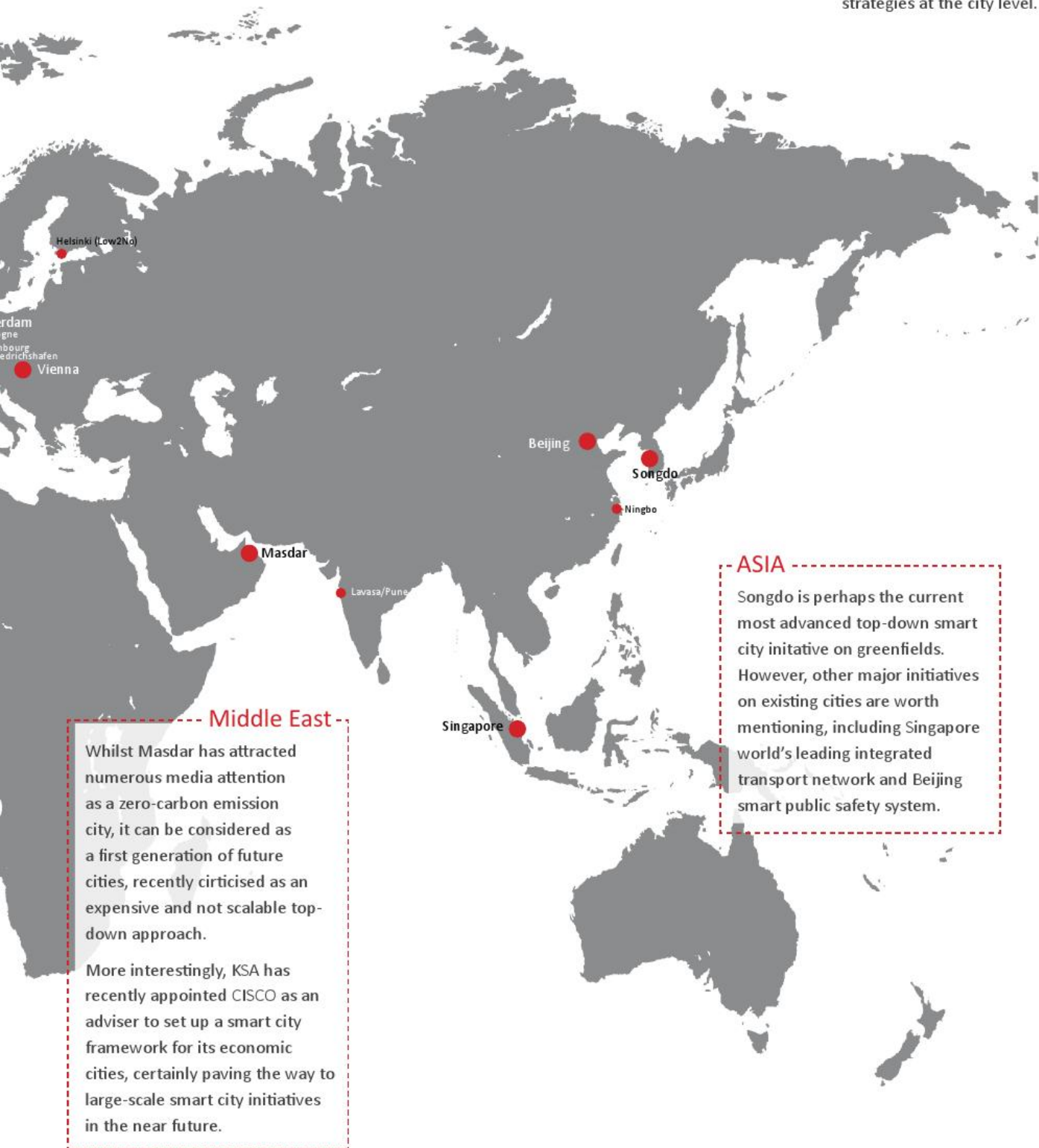
source: Danish Smart Cities: Sustainable Living in an Urban World



A GROWING TREND

Owing to the unclear use of terminology, it is difficult to identify worldwide Smart City projects. IBM alone, according to their own statements is involved over 2,000 smart city projects. Schneider-Electrics claims over 200 commercial initiatives. A New-York based research institute, ABI Research estimates at 102 the number of projects: 38 in Europe, 35 in North America, 21 in Asia and only 6 in the Middle-East.

The map below only lists a few cities around the World with smart city strategies at the city level.



A RANGE OF ACTORS

Smart is Everywhere

A range of papers, conferences, reports, white papers and brochures on smart city have been recently produced by a wide range of actors:

- Industrial Innovators (ie: Cisco, IBM, Ericsson, ..)
- IT and Utilities Providers (ie: Alliander)
- Software Companies (ie: Microsoft)
- Business Consultancies (ie: Accenture)
- Design Consultancies (ie: ARUP, BH, etc..)
- Public Local Authorities (ie: Amsterdam, Bilbao,..)
- Public Institutions (ie: EU)
- Think Tanks (ie: OVUM)
- Academics (ie: MIT Senseable City)

Moreover, a large number of these actors have a specific smart city dedicated team/department to promote the concept and offer consultancy services. Industrial Innovators, in particular, offer consultancies whilst selling technological solutions (hard/soft).



KEY TECHNOLOGY STREAMS

CONTEXT AWARENESS

The existing and fast growing streams of data about our location, consumption and tastes will reveal relevant insights in real-time to help us complete our tasks at hand, ponder alternatives, and make better informed decisions.

**Global mobile data traffic will increase
13-fold between 2012 and 2017**

*source: Cisco Visual Networking Index:
Global Mobile Data Traffic Forecast Up-
date, 2012–2017*

NETWORKING TECHNOLOGY

Networking Technology is about bringing higher broadband capacity with FTTH, 4G LTE and IP Multimedia Systems (IMS) as well as future networking technologies. These will enable the democratisation - at a reasonable cost for a high quality service - of Immersive Digital Environments.

Such environments enable, for instance, for less people travelling in and out the city, remote diagnosis in healthcare, and webstreaming of events. All these examples would contribute to reduce the level of congestion and wasted time and resources. Research areas such as Content Centric Networking (CCN) and Ubiquitous Computing are also promising faster processing that would increase the real-time capacity that is vital for mass interactions.

CLOUD COMPUTING

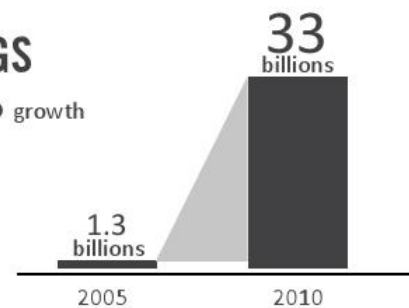
Cloud computing and its impact on Smart City solutions has been discussed in many foresight studies and reports. While in the short-term, cloud computing will be delivered by large commercial clouds, government G-clouds are promising models for (larger) cities, creating urban clouds that reduce IT costs, and providing platforms for small business applications and e-services. Cloud Computing is opening new possibilities in virtualisation of physical spaces, with added digital layers.

Extremely important is the expected standardisation of Smart City systems, platforms, and applications, which is necessary to provide on-demand self-services. Standardisation will accelerate technology diffusion and learning curves as city administrations and their IT departments will become aware of proven solutions for the main districts and sectors of the city.

INTERNET OF THINGS (IoT)

IoT is considered as a major research and innovation stream leading to create plenty of service opportunities in interconnecting physical and virtual worlds with a huge amount of electronic devices distributed in houses, vehicles, streets, buildings and many other public environments. These technologies open up a new innovation technology paradigm of spatial intelligence in cities, emerging from cloud computing, embedded smart sensors and devices, and open data.

RFID TAGS
+2500% growth



EMBEDDED SENSORS

Embedded networks of sensors and devices into the physical space of cities are expected to further the capabilities created by web 2.0 applications, social media and crowdsourcing. A real spatial intelligence is emerging having a direct impact on the services cities offer to their citizens.

Collective intelligence and social media has been a major driver of spatial intelligence of cities. Social media have offered the technology layer for organising collective intelligence with crowdsourcing platforms, mashups, web-collaboration, and other means of collaborative problem-solving. Now, the turn to embedded systems highlights another route of spatial intelligence based on location accurate and real-time information. Smart cities with instrumentation and interconnection of mobile devices and sensors can collect and analyse data and improve the ability to forecast and manage urban flows, thus pushing city intelligence forward.

TWO COMPETING EMERGING VISIONS?

THE URBAN OPERATING SYSTEM, OR THE TOP-DOWN APPROACH

A centralised design and use of Smart City developments leads to what has been deemed the “urban operating system” model.

Information collected through city-embedded sensors is centralised in a central “brain” system that processes information coming from different sources. The novelty is the amount of urban data (“big data”) but also the cross-sectorial nature of the experiment. The silos of data normally contained within each city agency or department are put together to reveal new patterns that guide public policy and day-to-day operations.

This is usually a type of Smart City driven by a top-down approach, where local authorities strongly lead the smart city strategy with the capacity of centralising information and decision-making. The other setting in which it can be more easily implemented is that of greenfield developments, for which the management of a city or neighbourhood can be supposedly planned to be centralised.



The potential problems arising with this model of Smart City development have to do with the responsible use of the centralised information, and its protection against hacking and cyber attacks.



THE SELF-ORGANISING SYSTEM, OR THE BOTTOM UP APPROACH

The decentralised model of Smart City developments is that of the “self-organising system”, relying on citizens to generate, share and make the most of data to inform decisions.

The self-organising system builds up on the power of the crowd. Local authorities are responsible in building a common platform, guaranteeing the availability of a pool of data to citizens and users of the city, regulating usage and responding to the needs of citizens.

NOT COMPETING BUT COMPLEMENTARY

These two approaches are in reality not competing and the most advanced smart city solutions integrate both aspects in two-way communication channels.



Data From Taxi Journeys, London
source: <http://urbanmovements.co.uk/>

B

KEY CHARACTERISTICS

SMART WATER SYSTEMS

Smart monitoring is a solution to reach maximum efficiency through the management and control of supply and recycling. Three possible levels of action can be reasonably explored: achieving maximum efficiency, detecting problems and reducing consumption through appropriate information to users.

SMART GOVERNANCE

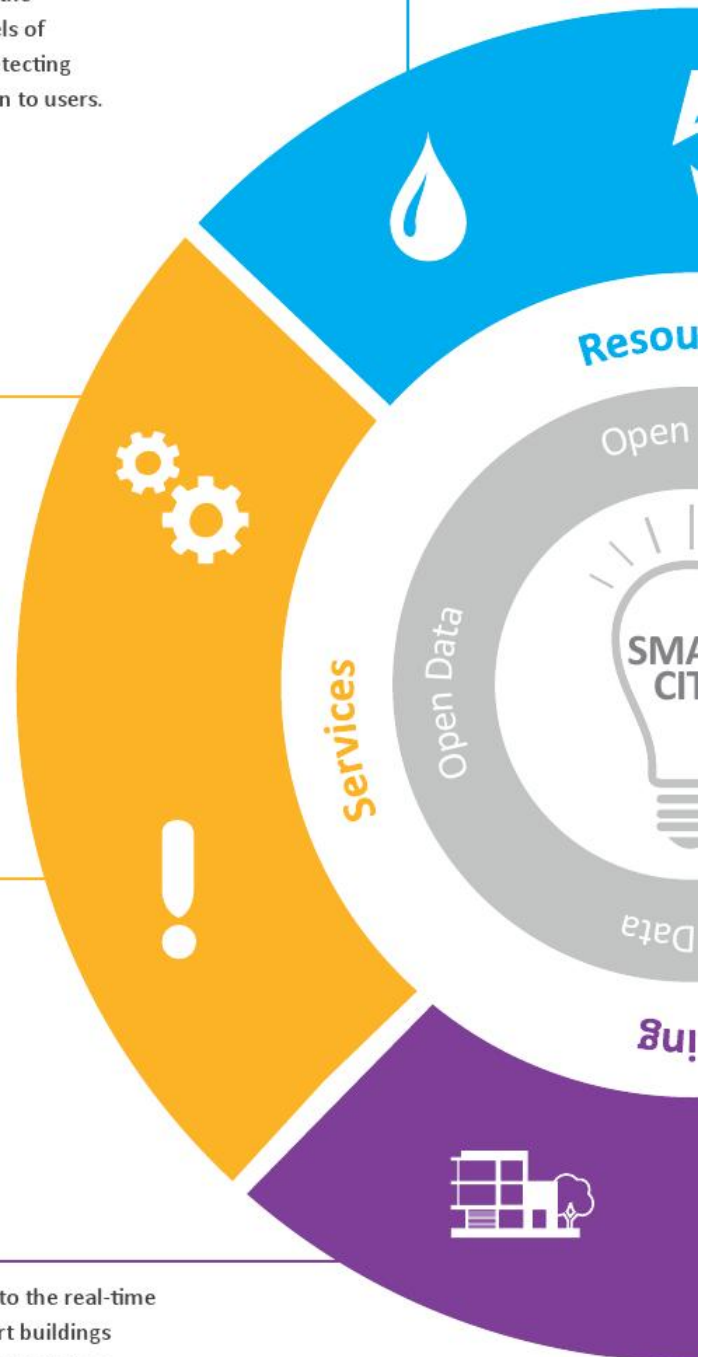
Governments institute structural changes in the way agencies measure performance and deliver services, thanks to data analytics and new delivery modules, such as shared services. These can help lead the way for more transformative efforts, a measurable return on investment and improved quality of life. User-friendly access to urban data and public service information for citizens, visitors and workers will significantly improve the degree of public and private services, as well as government accountability and citizen participation.

SMART PUBLIC SAFETY

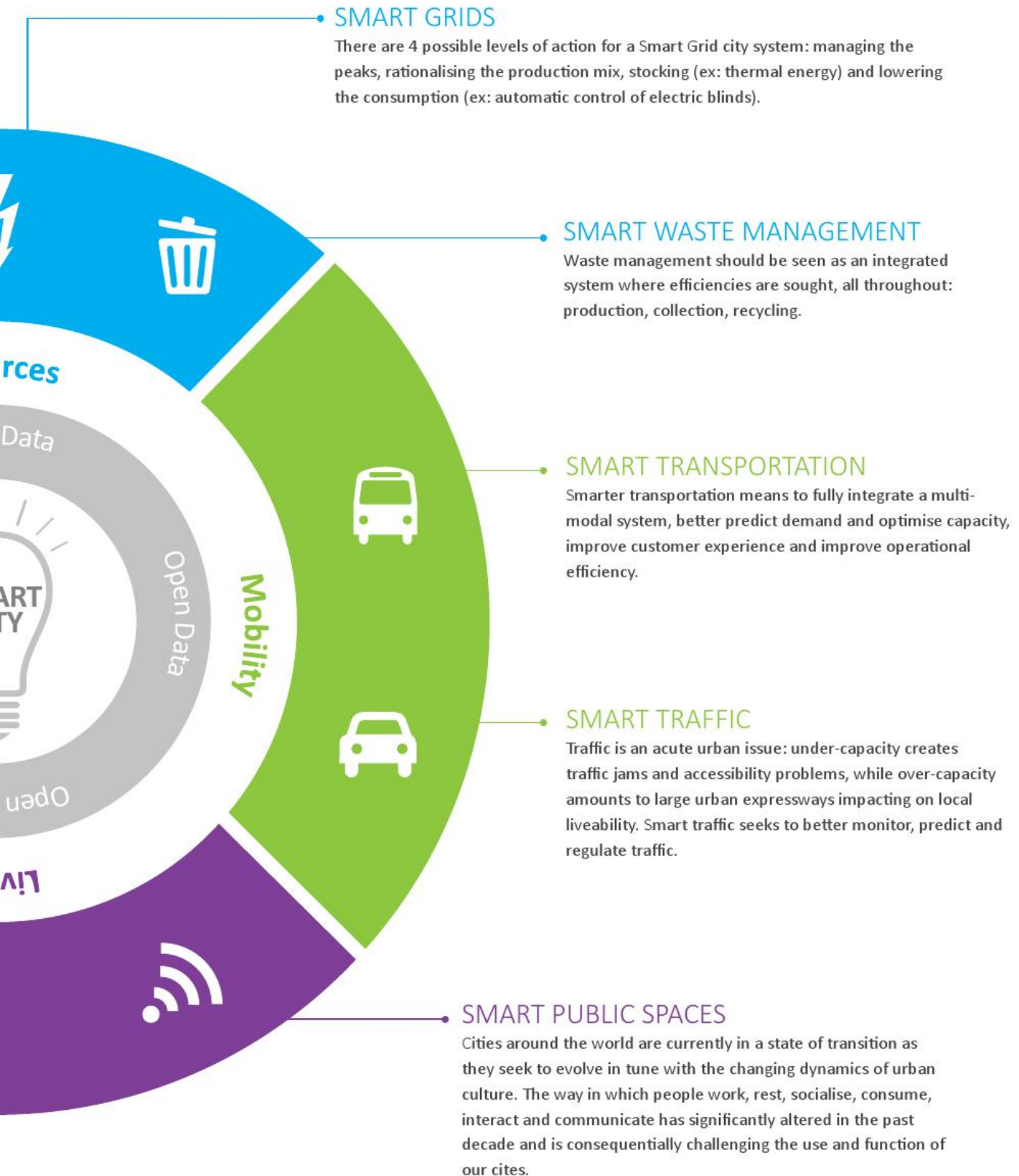
Public safety systems lend themselves to being highly interconnected with other city systems, such as health (emergency response systems, access to accident and emergency units, etc.) and transport (traffic management). They enable cities to deliver a coordinated response to a range of events, leading to improved citizen-centric services.

SMART BUILDINGS

The ability to collect, analyze and sort building data quickly is critical to the real-time energy and performance optimisation of a smarter building. But smart buildings should not just be considered as data sources, they are also to be considered as potential sources of co-generation power plants or reservoirs for water.



CORE SYSTEMS



FOCUS ON SMART WATER SYSTEMS

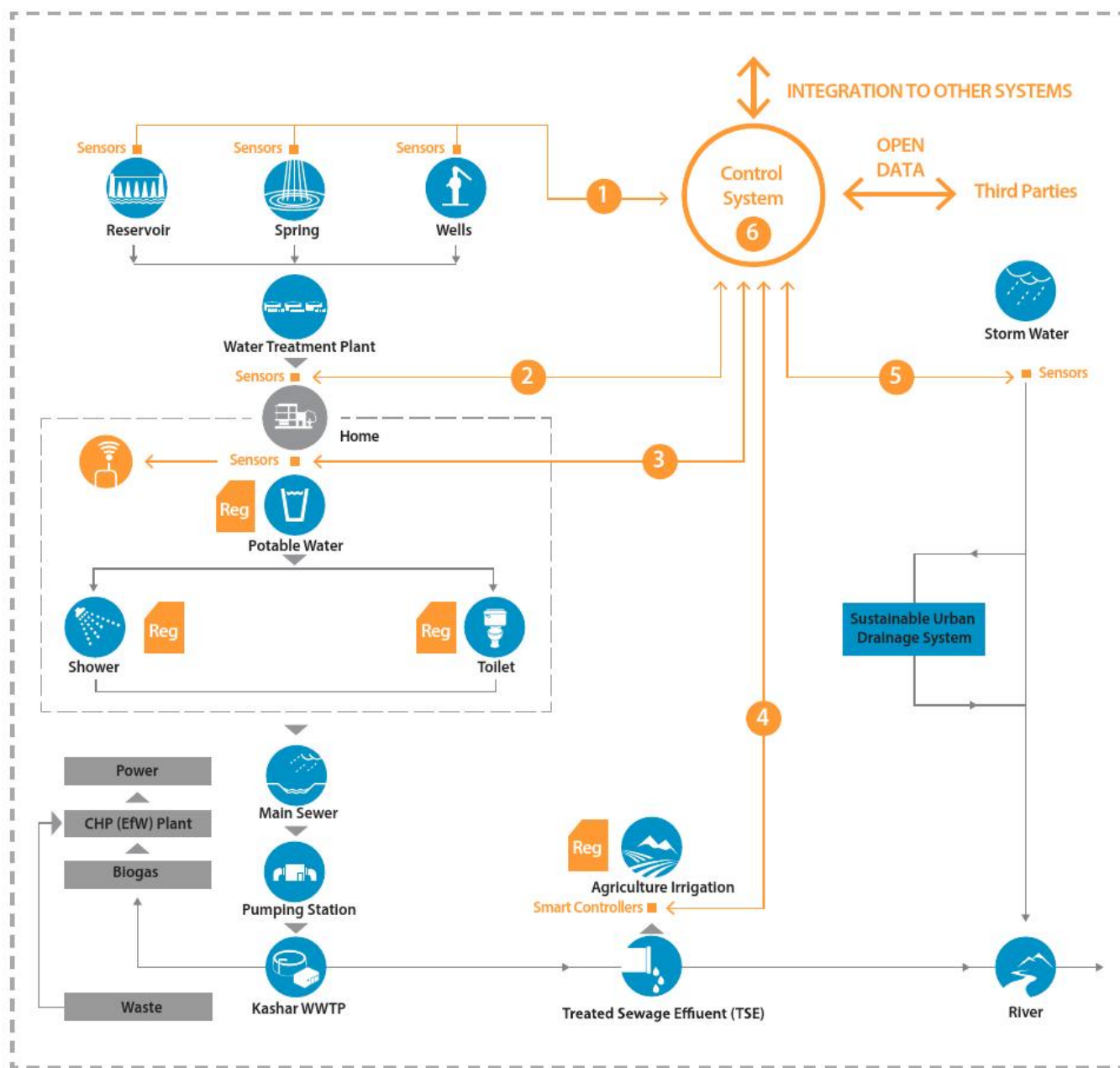


Water resources management is no longer the role of a single water company; it has to be considered from the general ecosystems' point of view.

In a competitive market for providers, smart monitoring is a solution to reach maximum efficiency through the management and control of supply and recycling. It seeks to attain an equilibrium for the system to become self-sufficient.

“A study estimated that for every million dollars spent on water efficiency in the US, it is possible to save as much as 10 trillion gallons of water, create about 220,000 jobs and increase economic output by as much as \$2.8 million.”

source: Alliance for Water Efficiency



1 Achieving Maximum Efficiency

Monitoring for better management of supply and recycling.

2 Preventing Problems

Smart monitoring to detect leakage in the water supply system.

3 Informing Users

Awareness on water consumption levels in public and private buildings helps to reduce water usage.

4 Regulating Usage

Controller that regulates watering according to environmental conditions.

5 Anticipating Flooding

Integrated Storm Water Management.

6 Forecasting Demand

Analytical tools to better anticipate future peaks.

FOCUS ON SMART WATER SYSTEMS

IBM SMART SENSOR NETWORK

Sensors can provide information about the state of pipes within the network and allow water companies to take proactive action on problems detected on the distribution network, and to improve control over assets.

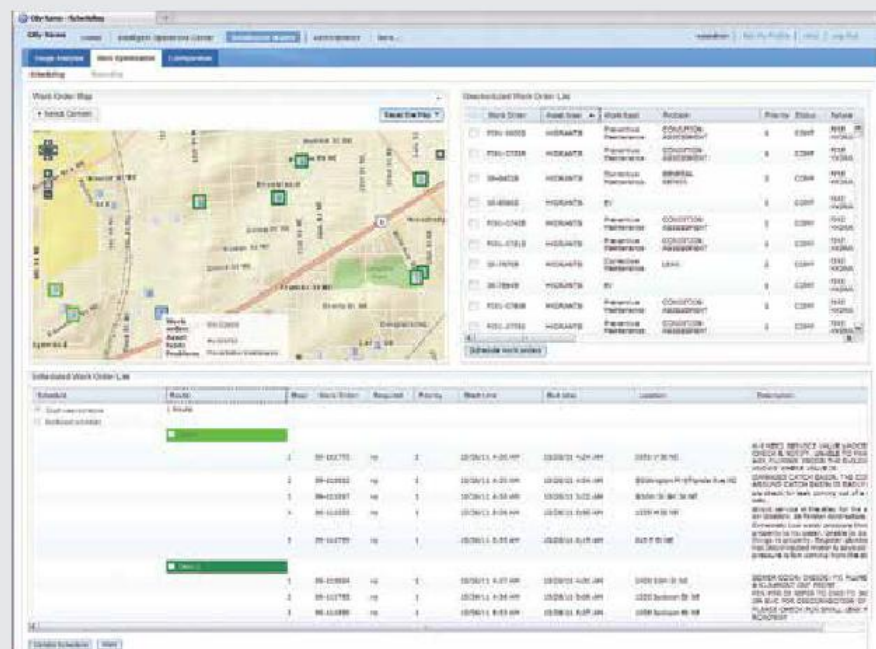
If resulting actions could be taken remotely no undue loss of service would occur: e.g. pressure regulation within a system, bypassing a section of pipe until maintenance is carried out; or self-healing triggered within a 'smart pipeline system' by the sensors themselves.



Source: IBM Smart Sensor Network

INTELLIGENT MANAGEMENT SYSTEM

For water utilities, a significant part of the budget is consumed by service operations such as repairing the infrastructure, responding to emergencies, performing preventative maintenance and conducting regular inspections. An intelligent management system uses advanced analytics and optimisation technologies to transform vast amounts of data collected from asset management systems, global information systems and water consumption databases into actionable insights that can guide decisions involving field resources, customer satisfaction issues, enterprise process transformations and business models.



Case Study

DC Water, in Washington, DC, has reduced customer support calls by 36% through preventive maintenance and the use of automated meter readings while accelerating dispatch of emergency investigations. In addition, crew optimization is expected to reduce the need for contract workers, saving DC Water approximately **\$1.8 million** annually while reducing fuel costs by 20%.

Source: IBM Smart Sensor Network

WEATHER-CONTROLLED IRRIGATION

HydroPoint's WeatherTrak system monitors local weather and landscape conditions to adjust watering patterns for urban landscapes. Businesses and local governments that have landscapes to water can do it more efficiently using such systems.

Case Study

Lockheed Martin's Sunnyvale facilities in Silicon Valley include two sites spanning across 500 acres of land in total, generously landscaped with a wide variety of plants that create settings employees describe as park-like.

After discovering that ordinary irrigation timers overwater landscapes by 30-300%, Lockheed Martin estimated that watering with a smart weather-controlled irrigation would lead to **126 million gallons of water saved each year**. The annual cost of such currently wasted water easily reaches seven digits in water bills and in the many hidden costs of over watering: cracked foundation, asphalt resurfacing, frequent plant replacement and mold.



The proven leader in smart water management.



Source: HydroPoint Website

URBAN FLOOD (EU)

The UrbanFlood project, which is an EU funded project, is aimed at establishing an early warning system framework that can be used to link sensors built in flood embankments, via the Internet, to develop predictive models and emergency warning systems.

Early warning systems will thus have an increasingly important role in mitigating such risks through early detection of conditions and predicting the imminent occurrence of a disaster, and by providing real time information during the event. The sensors can also help in the inspection of the structural integrity of the levees and dams.

In addition, the ability to predict whether water retaining infrastructure can withhold the mounting pressure of the rising waters is essential in order to be able to give enough time for a large-scale evacuation if the need arises. In the Netherlands, the Ukdijk Foundation, as part of the UrbanFlood project, has been working on building smart levees, levees with a network of built-in wireless sensors.



The sensor used to monitor soil deformation is the TenCate GeoDetect13, which is the world's first intelligent geotextile¹⁴ fabric and is equipped with optical fibres as well as instrumentation equipment and software. Smart levees can provide information about the level of water, the pressure being exerted on the infrastructure, early warning of soil deformation, changes in temperature, strain. It can also predict 42 hours in advance whether the levee will break.

FOCUS ON SMART GRIDS

The electricity system forms a unique supply chain because the laws of physics demand that production, delivery and consumption occur instantaneously and have to be kept in perfect balance on a continuous basis. An ideal challenge for a more efficient system, with potentially high savings.

We have identified 4 possible levels of action for a Smart Grid city system: managing the peaks, rationalising the production mix, stocking and lowering the consumption.

“San Diego evaluated the benefits of its Smart Grid Implementations at **\$2.7 billion over 20 years with a payback period of **3.5 years only.**”**

source: San Diego Smart Grid Study, 2006

Not surprisingly, an important percentage of smart city solutions have recently focused on energy, thanks to numerous initiatives from energy providers and distributors, as well as incentives from local and national policies across the world. It is possible to identify 4 possible levels of action for a Smart Grid system:

1. DISTRIBUTION: MANAGING THE PEAKS

Energy demand varies greatly between different times of day and seasons. At peak time, electricity costs more to generate; one key level of action is therefore to manage efficiently the peak needs in energy by shifting some demand by a couple of hours than to extend the capacity of generation; this method is called **Time-Shifting Demand**.

Including "intergrators" within the energy distribution system has for example enable the French Power Provider ERDF to level out peak consumption rates by "buying" the rights to lessen the supply of energy to certain consumers willing/able to do so. Commercial consumers such as supermarkets are the first targets of the system, for example by timing their refrigeration load outside the peak hours.

The charging of Electrical Vehicles, expected to become a major new demand load in the next decades, could be also timed accordingly to avoid the need for more generation capacity.

2. PRODUCTION : RATIONALIZING THE MIX

A second level of uses concerns the production and use of alternate power. This encompasses 3 sources: Power Co-generating, solar power (photovoltaic, thermal solar power, solar farms), wind power. How does one manage the use of this power, often produced in periods of time when they

are not most needed? How does one manage efficient distribution knowing that there can be several power plants, issuing different levels of energy and often far apart? This could dramatically change the way we operate the overall system, moving away from the current model based on a single system operator, and potentially offering benefits for managing future complexity.

3. STOCKING

Stocking power is the third issue we will have to consider. It is currently technically impossible to stock electrical power efficiently and economically. It is however feasible of stocking thermal energy which is a more efficient way and potentially convert the calories into electrical power. Materials with a capacity to phase-change will stock heat and the production of ice will permit underground stocking of cool.

4. CONSUMPTION

The 4th level of action consist in reducing consumption and energy demand. This can be achieved through active and passive solutions. Passive solutions involve for example the construction of low consumption buildings. This can be achieved by the monitoring and controlling devices that will be implemented in building construction. Examples of these devices are for instance: automatic regulation of domestic appliances (auto/onoff), control of electric blinds when shading is necessary.

Active measures relies on the consumer awareness of its own consumption, thanks to smart meters. Combined with clear economical incentives, this represent a very cost-effective solution to reduce energy demand.

FOCUS ON SMART METERS

Smart meters is a tried-and-tested solution which has attracted a lot of attention of policy-makers, in particular in Europe and in the US. The complete roll-out of smart meters in the UK is scheduled for 2019, representing one of the most important public investment in the country.

A smart meter is different from a conventional meter in a number of ways. First it can measure and store a lot more information. Secondly, it can send and receive data from another party, making possible a range of new services:

- a smart meter allows electricity suppliers to read meters without visiting the property,
- for those generating electricity (ex: solar panels on the roof), the smart meter will provide accurate measurements of exported electricity. The complexity of managing multiple



source of local production requires accurate data in an integrated system.

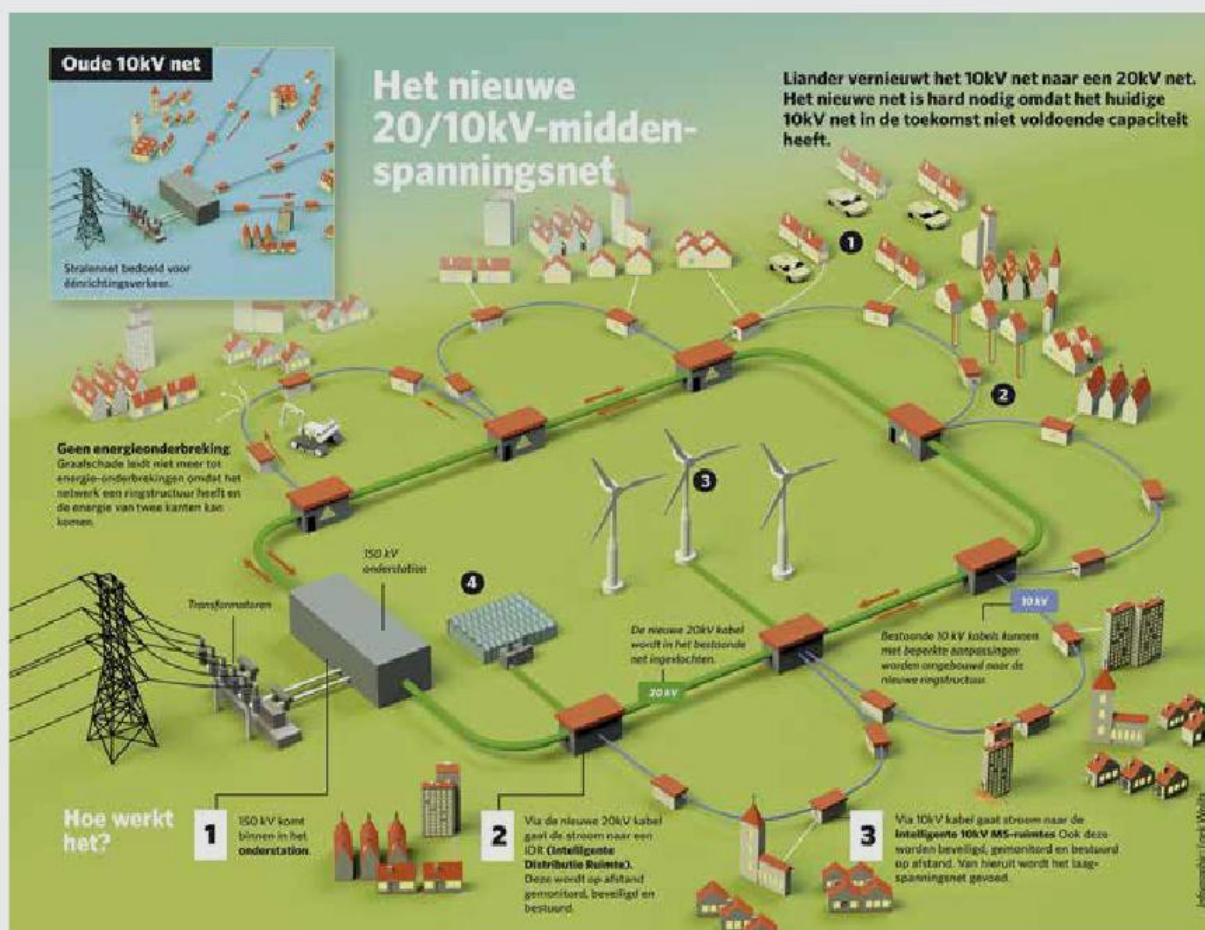
- smart meters will help retailers to reward consumers who are able to shift some of their demand away from peak times, through personalised information.

FOCUS ON SMART GRIDS

NEW WEST AMSTERDAM

Amsterdam New West is a district of approximately 40,000 households, of which 10,000 are served by a new Smart Grid. New West has a high penetration of smart meters and contains the largest amount of solar panels in Amsterdam.

The Smart Grid at New West is a 30 million euros initiative, involving 40 partners and more than 100 stakeholders. The program is managed by the Amsterdam Smart City Foundation, owned 50% by the City of Amsterdam and 50% by Liander, the Dutch energy distribution operator. The system contains a wide range of sensors and intelligence supported by an ICT network which allows for the following key elements: continuous monitoring (1), intelligent substation (2), intelligent secondary substation (3), flexible bi-directional grid (4), fiber optic telecom and smart metering.



Source: Liander Smart Grid Developments Presentation

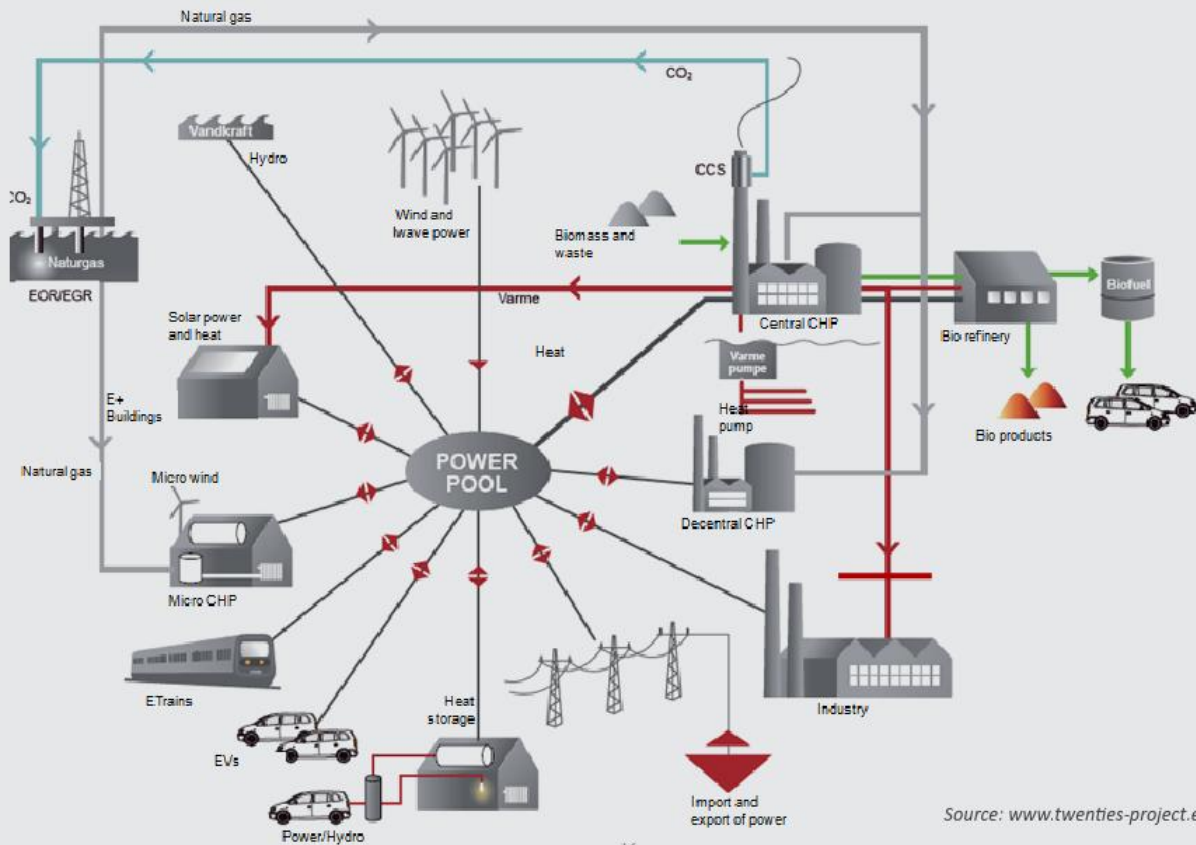
Consumer benefits include: reduction of the number and duration of power outages, better opportunity to feed consumer-produced electricity back to the grid, increased capability to support the integration of electric-powered vehicles, prevention of large price increases for electricity transmission, enablement of active participation in a sustainable energy supply.

The New West Amsterdam Smart Grid initiative has shown the necessity to involve an important number of technical partners as well as local stakeholders for this integrated system to materialize.

VIRTUAL POWER PLANT BY DONG ENERGY

The Virtual Power Plan (VPP) is a system created by DONG energy, Denmark leading energy company. VPP controls the behaviour of a large amount of Local units (LUs). The LUs are both power-consuming and power-producing units. The producing units could eg be small hydro plants, emergency gensets or wind turbines. The consuming units could eg be cold storage facilities, greenhouses or drainage pumps.

The important aspects of the units are that they have some flexibility in how they consume or produce energy. The VPP has to control the units in such a way that they support the energy system when power consumption and production are not in balance.



Source: www.twenties-project.eu

Building the operational platform and business process integration is not trivial. It can be split into three main groups: building the conceptual solution, attracting and installing control of the LUs, running the daily operation, selling and producing services by optimising the LUs. VPP was implemented in Denmark on a small scale, where 47 local units were integrated using 15 different technology and managing 31 MW with promising results.

UK SMART METERS DEPLOYMENT

UK has decided on a nationwide rollout of smart metering across 50 million households and businesses by December 2019. Legacy meters will be replaced by new, smart electricity and gas meters at a rate of 30,000 a day. In addition to the benefits it will deliver to the wider energy system, it also represents a significant commercial opportunity.

SmartGrid GB, an independent, cross-industry stakeholder group acting as the national champion for smart grid development in Britain has found that smart grid development could cost £19bn less than traditional reinforcements to the grid over the period between 2012 to 2050 and could stimulate an export market in goods and services worth up to £5bn to the British economy.

FOCUS ON SMART TRANSPORTATION/TRAFFIC

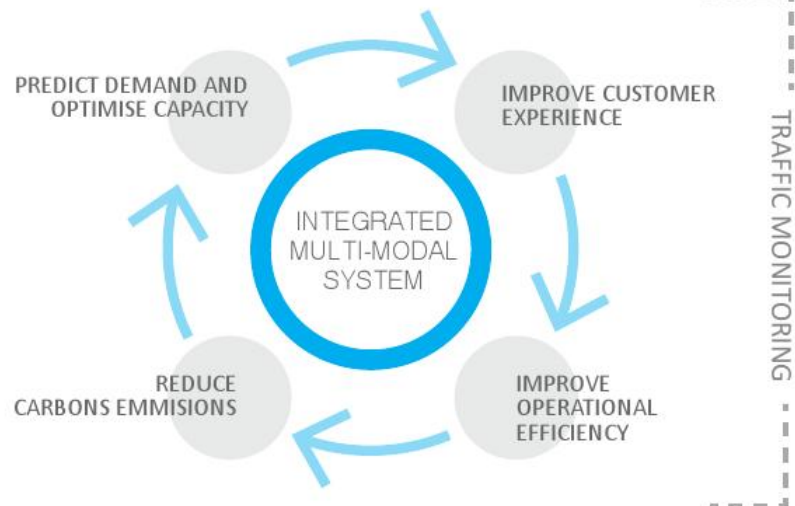


Smart transportation means better systems for rail, air, public transit and freight. These can improve our cities, our economy and our daily lives.

In a smarter transportation system, travellers and freight customers are empowered with information and tools to determine for themselves the best way to move from origin to destination, throughout all modes of transportation, with due consideration to cost, time, convenience and environmental impact.

A Smart Integrated Multi-Modal System has to be planned and incorporated in the masterplanning process.

This involves an adapted scale of proximity and mobility.



PREDICT DEMAND & OPTIMISE CAPACITY

With analytical tools, transportation providers can predict demand, align capacity and deploy assets, continuously adapting operations across the entire network.

IMPROVE OPERATIONAL EFFICIENCY

Many cities are sitting on potential treasure troves of data that could help them improve their transport systems. First, leaders need to assess the full range of what they already know and then couple that with data being collected outside the traditional network.

ENHANCE CUSTOMER EXPERIENCE

For maximum efficiency, the system has to help city dwellers to make the right choice of the most appropriate transportation at any given time and hence must be connected to a unique traffic information platform. Information on public transport, pedestrian, cycle and car interconnections must be provided in real time and on all scales. "Ticket" offices must give access to vehicles as well as public transport very easily.

REDUCE CARBONS EMISSIONS

The challenge of smart mobility is to foster both seamless mobility and enhanced ubiquity for the whole of its inhabitants, visitors and workers, while lowering CO₂ emissions generated by transports.

"In the United States, congestion in urban areas results in annual costs of 4.2 billion hours of wasted time and US\$87 billion from wasted fuel and lost productivity."

source: IBM "Smart Cities for Smarter Growth"

"An integrated management system with real-time data can yield for Logistics up to 27% fuel savings."

source: The Climate Group

FOCUS ON SMART TRANSPORTATION/TRAFFIC

BEIJING TRAFFIC CONTROL CENTER

The Beijing Traffic Control Centre is responsible for monitoring and managing traffic flow throughout the city, overseeing variables such as civil aviation, bridges, railways, highways, and street traffic. Traffic Control Centre personnel rely on data transmitted via 3600 signals from 13 different departments to monitor traffic flow, allocate resources, and respond to emergencies in a timely manner.

Before the construction of a single, centralised traffic control facility, traffic management in Beijing was carried out by 13 different departments, each of which was tasked with overseeing a distinct segment of the city's vehicular traffic, pedestrian traffic, mass transit, and other types of traffic. This decentralised approach hindered the ability to achieve optimal levels of efficiency, collaborative capability, effective decision-making, and timely emergency response.

Centre managers report that, since the introduction of the new video display wall, substantial gains have been made in terms of collaboration, knowledge management, unity of purpose, responsiveness and strategic planning.



source: Jupiter Website

VELIB/AUTOLIB (PARIS)



Vélib' is a large-scale public bicycle sharing system in Paris, France. Launched on 15 July 2007, the system has expanded to encompass around 16,000 bicycles and 1,200 bicycle stations, located across Paris and in some surrounding municipalities. Since December 2011, Vélib' has been complemented by an electric car sharing scheme operating on similar principles, dubbed Autolib'. Vélib' is operated as a concession by the French advertising corporation JCDecaux.



All the real-time data generated by the bike sharing system was shared in 2012 by the municipality, and numerous applications were rapidly created by users - they dramatically improved the service and triggered innovation.

SINGAPORE INTEGRATED TRANSPORT SYSTEM (IBM)

Singapore's Land Transport Authority (LTA) leverages smarter transport to increase ridership and reduce traffic congestion:

A seamless national transport fare system was created to enable riders to use a single card of their choice to pay for all modes of travel as well as vehicle congestion charging and car parking. The solution creates a user-centric service.

The system also generates insights from the 20 million trip-related transactions generated each day – information on where, when and how riders are travelling – to optimise routes, schedules and fares.

The Singapore Land Transport Authority has created one of the most modern, affordable and heavily used public transportation networks in the world, with nearly 3 million people riding buses and 1.6 million people riding trains on any given day.

Other benefits include an 80 percent reduction in revenue leakage from “lost” transactions because of systems issues and a 2 percent reduction in the overall lifecycle cost of the fare processing system.



source: LTA Website

Shorter delays and lower traffic congestion on expressways alone result in **US\$28 million** annual savings

SMART CITY ARCHITECTURE

Goals & Targets

Development Vision / Efficiency Targets / Sustainability Goals

Governance

Public-Private Partnerships / Strategic Planning / Networked Information Economy

Citizens

Residents / Visitors / Tourists / Businesses / Employees / Innovators



Stakeholders



HORIZONTAL INTEGRATION

Soft Infrastructure

Integrated City Management Systems / Building Management Systems /
Open Government Data Platforms / Big Data Management Softwares

Core Systems



HORIZONTAL INTEGRATION

ICT Infrastructure

fiber optic networks / single IP network / ubiquitous Wi-Fi

Hard Infrastructure

water networks / sewage system / smart grid / network of sensors /
district cooling / multimodal transport system

Environment & Natural Resources

natural resources / environmental conditions / topography

VERTICAL INTEGRATION

"The network has become the next utility"

John Chambers, CEO of Cisco Corporation

A NATURAL MONOPOLY

Supplying embedded network services in a broad-ranging set of services (water, energy, waste, transportation, statistics, public safety, buildings...) gives the provider a long-standing privileged position, yielding long-term contracts with the city.

FOCUS ON HORIZONTAL INTEGRATION

THE NEED FOR CROSS-SECTORAL INTEGRATION

The availability of large amounts of data in different sectors of government and business, increased by the implementation of multi-dimensional sensors in city infrastructure, faced policy-makers with a dilemma: could such large data pools be used to improve urban management? Vertical integration from visions to projects through public-private partnerships and networks, urban services and technologies, undoubtedly leverages the capacity of policy-makers to deliver cost-effective solutions for their cities. However, horizontal integration is another challenge that city officials are taking up to increase the efficiency of their projects.

Horizontal integration was prompted by the nature of the sensor and technologies related to Smart City developments: indeed, sensors that are embedded in urban infrastructure provide information that serves primarily a sole function. If the different streams of data are integrated horizontally, breaking the silos of knowledge between city departments, efficiencies are multiplied as different departments can often benefit from cross-department knowledge that they would not have the resources to produce.

THE CHIEF TECHNOLOGY OFFICER: FROM BUSINESS TO CITIES

Horizontal integration is about making knowledge available, but more crucially about the proactive use of cross-sectoral knowledge. In this perspective, a figure from the business world has come forth as a relevant addition to urban management: the Chief Technology Officer.

Coming from the business sector, the Chief Technology Officer is an executive position initially designed to anticipate long-term technological trends for IT firms. Given the pervasiveness of cutting-edge technology in all sectors of the economy, this position has been increasingly replicated in non-IT based companies. Cities as complex systems require understanding and integration of its different components, and the forecast of future policy enabled by state-of-the-art technology: many of them have thus started to equip themselves with Chief Technology Officers.

Cities like Chicago, Seattle, New York, Philadelphia or San Antonio have created chief technology officer functions, on which pivot Smart City strategies.

The Chief Technology Officer sets technology standards and strategies for the city, and is bound to work across departments, as all city strategies rely on the use of technology.

John Tolva joined the city of Chicago as Chief Technology Officer after 13 years of work at IBM. He was hired with the objective of setting high standards for open, participatory government for all Chicagoans. The goals of its function are the establishment of city-wide technology and innovation priorities, interfaces with the global technology industry, and modernised, streamlined city IT systems. Chicago, which is planning to spend \$7.3 bn in infrastructure over the next two years, has recently been the object of a study by the



FOCUS ON ICT INFRASTRUCTURE

The ICT infrastructure layer plays a key role in smart cities environment. The co-existence of a certain number of information technologies requires the use of common open platforms. The Celtic-Plus Purple Book, an initiative of European telecom operators, identified 4 stages for the implementation of Smart Cities:

Stage 1 - Network Infrastructure

The infrastructure for the single IP network must be considered during the planning stage for maximum impact. Fiber optics should be installed as an integral element of each building during construction.

Stage 2 - Content and Communications

The infrastructure lights up core services, delivering telephony, internet access and VoD over a single network to enable different smart solutions.

Stage 3 - Intelligent Infrastructure

Sensors and interconnections are introduced and run under intelligence management systems (links with soft infrastructure).

Stage 4 - E-Services

Value-added services and applications are introduced for information sharing to citizens, businesses and other service providers.

HARD-WIRING INNOVATION INTO THE CITY

Smart City projects carry the potential to spark economic development, reconfigure urban policy, and renew a city's

image.

REBRANDING THE CITY

IBM's "Smarter Cities Challenge", a US\$50 million initiative launched in 2010 for a 3-year period, was directed at 100 cities all over the world, selected according to their commitment and their innovative thinking. Rabat, Jakarta, Atlanta, Johannesburg... the cities involved are greatly diverse, but are all challengers in the global urban competition. The displaying of their forward-thinking strategies with Smart City developments is helping them to move to a higher position.

In the meantime, cities like New York, Singapore and Barcelona are securing their world-leading positions for urban innovation by heavily investing in Smart City developments. Barcelona has just given way to the development of a plan for intelligent public lighting, with lamp posts embedded with sensors measuring various types of information, from CO₂ levels to noise.

Smart City initiatives can also be used to address social challenges in the fields of education, health and security, which hinder a city's ability to attract investments, tourism, and to develop soundly. With the support of IBM, Memphis, Tennessee, developed analytics and 'predictive policing' as a means to improve its public safety.

For contenders in global urban competition, Smart City developments bring about substantial benefits for economic development, harnessing a city's competitive edge while lifting it to world-class technological standards, but they are also a prime occasion to turn a city's image around and put it on the map, attracting a further flow of investments and triggering a virtuous circle.

African and Middle-Eastern cities are currently under-represented, revealing a great potential for development of such strategies in these regions.

A SPRINGBOARD FOR ECONOMIC DEVELOPMENT

A United Nations Environment Programme report from April 2013 shows that investment in sustainable urban infrastructure boosts economic growth, by cutting costs and restoring health. In Melbourne, carbon emissions dropped by 40 % after the introduction of energy efficiency measures in public buildings, while in Cape Town, South Africa, a re-fit of low income housing with solar water heaters and efficient lighting has saved over 6,500 tonnes of carbon per year, cut respiratory illnesses by 75% and reduced the cost of hot water for poor households.

The efficiencies produced by Smart City developments bring about economic gains, as the reduced costs for businesses taking advantage of Smart City resources directly impact their capacity to invest in their expansion.

Smart City technologies, when taken up by local firms, allow them to move into new industrial sectors. As these technologies are cross-sectoral, they induce growth in any type of industry, and can thus help boost local capabilities and existing activities.

TRANSFORMING URBAN MANAGEMENT

As Smart City developments focus on data production and analysis, the consolidation of large data sets across government agencies is one of the main recommendations coming from IBM's Smart Cities Challenge: data on transportation can affect economic development, and data on public safety can be relevant to housing policy. As data silos are united, information is more readily accessible to city departments, as successful IBM pilot projects have shown in Saint Louis, MO, Providence, RI and Ho Chi Minh City, Vietnam.

Department sharing of information is a paradigm shift in urban management, as it allows both for enhanced policy design and implementation from individual departments, which benefit from the most relevant cross-thematic information, but also for better decision-making from city government, which instantly centralises all relevant information. At a TED talk entitled "The four commandments of cities", Eduardo Paes, the mayor of Rio de Janeiro, presented his city's integrated operations centre developed with IBM. This decision-making hub centralised all relevant information in real-time, strengthening both the administration of day-to-day operations and reactive risk-management, in a city prone to heavy storms and floods.

OPEN DATA TECHNOLOGY AND POLICY

“Cities are turning into vast data factories”

The Economist, 27 October 2012

OPEN DATA PRODUCTION, COLLECTION AND ANALYSIS

Cities are sources of enormous amounts of information associated with their every function. Be it through water and energy consumption, internet and telephone use or transports patterns, large datasets are continuously produced in the city. Smart City solutions contribute to embedding sensors in all city functions, in order to produce an even larger quantity of data encompassing all activities. The collection of data, that is, its public access, is the target of open data policies. Technological packages developed by the private sector set up platforms making datasets from different sources available through one portal. Socrata, a Seattle-based firm, is the leading developer of Open Data services, transforming information assets coming in various forms into consumption-optimised data. They also offer tools to process the data, thanks to analytics that cater to the needs of city users and firms.

THE IMPULSE OF THE PUBLIC SECTOR

The free access to a pool of public data is the result of shifts in public policy practice. In December 2009, Barack Obama's administration issued Executive Order M-10-06, the “Open Government Directive”, requiring departments and agencies to achieve the following: publish government information online, improve the quality of the information, institutionalise a culture of open government, create an enabling policy framework for open government. The executive branch then released in May 2012 an open-source interface, Open Government Platform, for any government to subsequently deploy.

In the UK, the Open Government Data initiative and the Government Digital Service have been implemented as a result of several campaigns to make the data that was collected by public bodies available to citizens. Similar goals have been followed in Canada, France, Norway, Finland and Brazil.

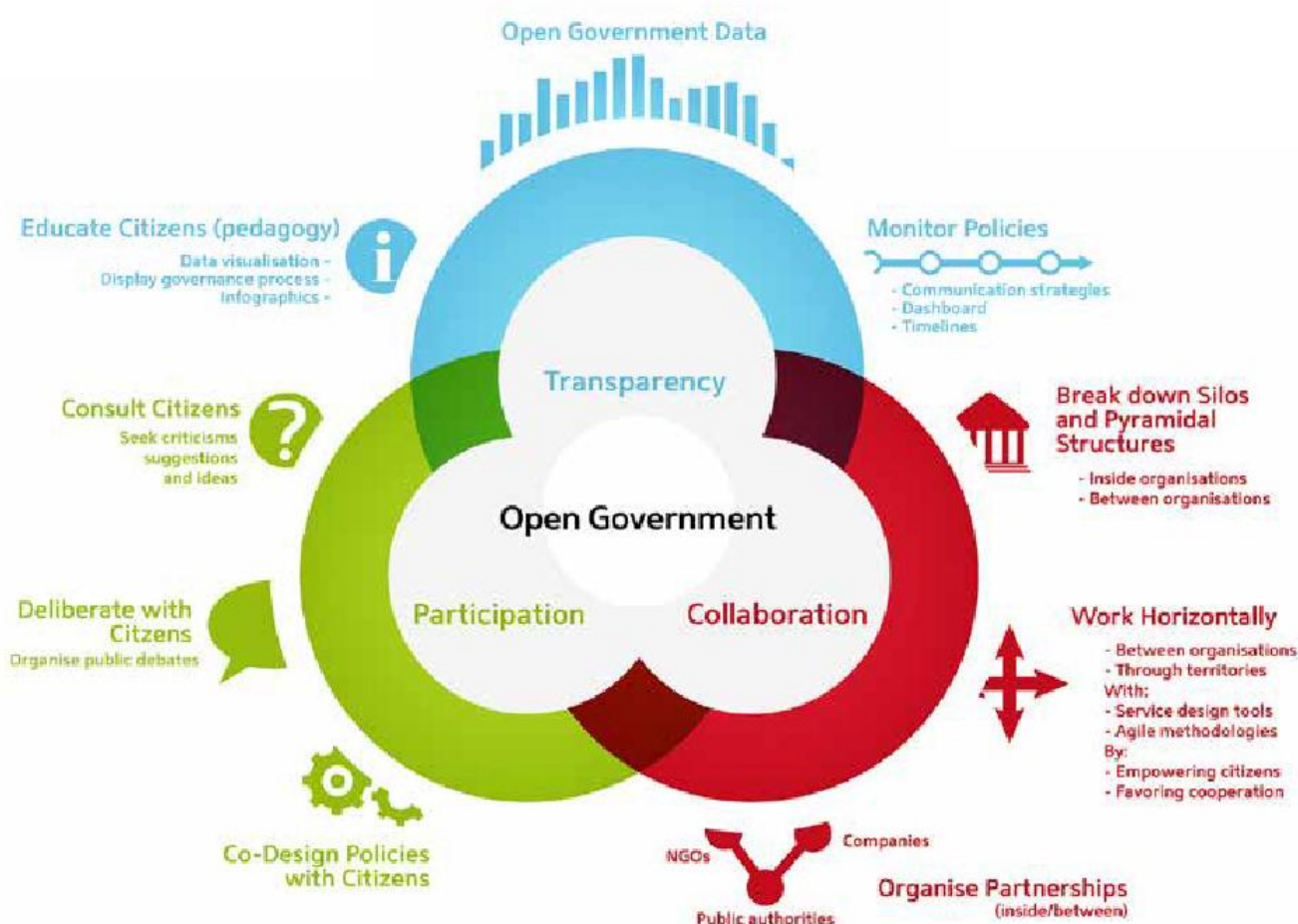
PRIVATE SECTOR OPPORTUNITIES

Open data profoundly alters the organisation of markets: it reduces or changes traditional intermediaries that are used to obtain information, it extends the possible use and interpretation of data beyond the local context, and prompts the emergence of new markets. Disintermediation is exemplified by recent developments in the tourism market: consumers have direct access to an increased amount of information, and prices are to decrease.

A recent example of the creative use of open data by a private corporation is to be found in Abidjan, Ivory Coast. Using 2.5 billion call records from 5 million mobile phone users released by Orange, IBM created new transport solutions for the city. This anonymised data, the largest of this sort ever released, provided location information, helping to predict transport patterns and conceive potential improvements for bus routes, in order to reduce travel times by 10%. Project managers highlighted that if information silos had been merged, for instance by integrating city data on transport, they could have proceeded to a full redesign of Abidjan's transport system. This project, presented at th MIT in May 2013, reveals how open data policies can unleash business opportunities improving the urban experience.

“Just as cheap fish increases the demand for chips, so free data increases the demand for, and raises the value of, complementary resources and skills.”

Tom Slee, technology and politics commentator



source: Democratieouverte.org

“Access to public data
is estimated to be worth
€27billion in the EU only”

source: IBM “How Smart is your city?”

6

IMPLEMENTATION

INSTITUTIONAL FRAMEWORK

Smart City initiatives are large-scale, complex developments that require cooperation among players to drive their implementation. To this end, two general types of governance structures have been experimented in current Smart City projects.

THE INCREASED COMPLEXITY OF URBAN ISSUES

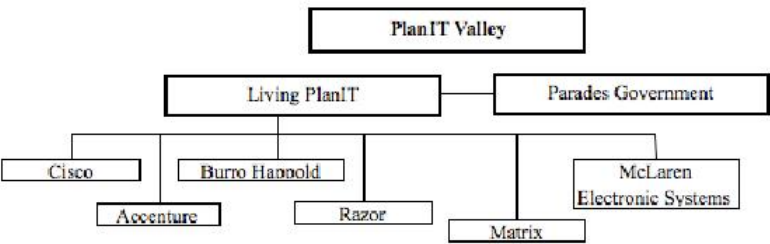
Urban projects are no longer managed through top-down, mono-dimensional policies. The growing complexity of the issues at play in cities, heightened by globalisation processes, has quickly reduced the capacity of central states to address them single-handedly. In fact, the increased globalisation the world has witnessed in the last decades has been concomitant with a growth in power and resource devolution: sub-national structures and regions are now more and more the relevant scale for action. The fragmentation of public policy has been accompanied by the involvement of a plurality of private actors with varied expertises, and also with citizen participation at the local level. Urban projects are thus increasingly bottom-up, designed and implemented by an intricate network of actors with a main steerer. Public-Private Partnerships (PPPs) are only one type of institutional arrangement, greatly simplifying the phenomenons at play.

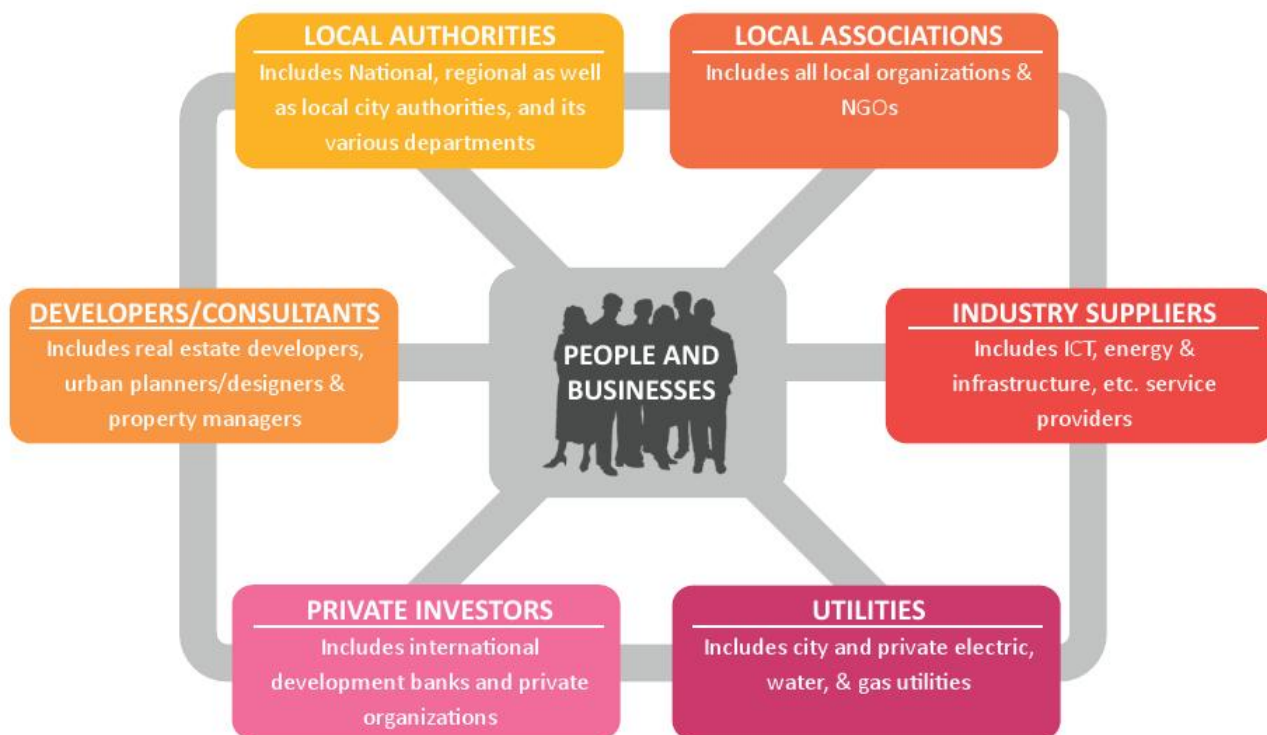
PROJECT-BASED INSTITUTIONAL ARRANGEMENT: THE VIABLE CHOICE

In this context, large urban projects are no longer designed, implemented and evaluated by a unitary structure, but come into being through the frequent negotiation among a variety of actors that come together for a particular project. Public actors are frequently at the centre of such projects, but with two major differences compared to the previous period: they are fragmented among levels of government (municipal, regional, national, and sometimes transnational, as in the EU), and they are no longer providing for the bulk of resources as they did in the past. The increased budget constraints of public structures have prompted them to elaborate new ways of managing urban projects, adopting the role of steerer rather than director. It is through the subtle use of incentives, labels and best practice diffusion that private and civil society actors are brought to operate in a manner that fits with governmental objectives.

xxxxx

In the case of Santander, Smart City developments have involved up to 100 different actors that have intervened all throughout the process: xxx





“One of the major challenges when it comes to devising and implementing a Smart City strategy is the complexity of the city itself and of the (decision-making) processes that need to be put in motion to change the status quo.

This challenge often materialises in the form of understanding the potential solutions for the city and overcoming very practical barriers that concern the regulatory environment, decision-making processes, and existing governance mechanisms.”

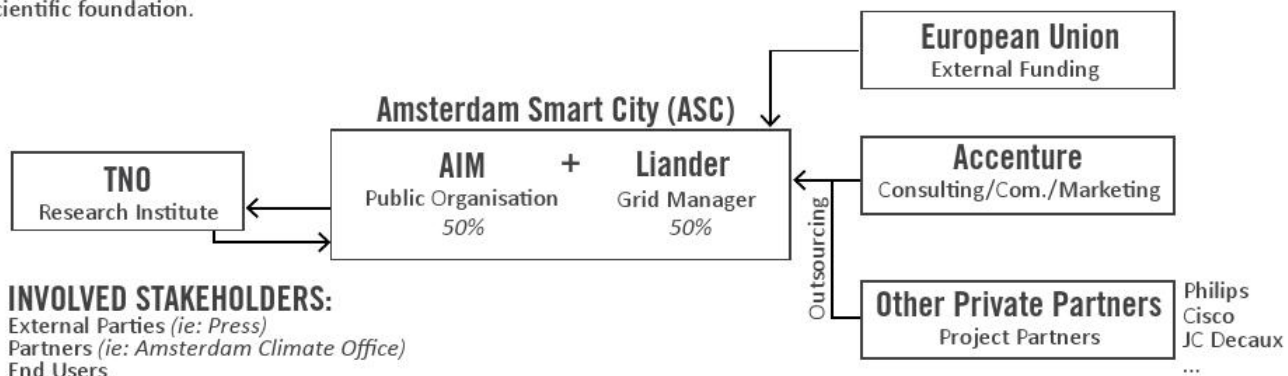
*source: EU Smart Cities Stakeholders Platform
Integrated Action Plan (2013)*

CASE STUDY: AMSTERDAM

AMSTERDAM SMART CITY: A PPP SETUP

The Amsterdam Smart City (ASC) project was initiated in June 2009 by the public organisation **Amsterdam Innovation Motor (AIM)** and private grid manager **Liander** in close collaboration with the Amsterdam Municipality.

TNO, an independent research institute, joined forces with Amsterdam Smart City to make sure that the research results would be recorded, underpinned and shared based on a rigid scientific foundation.



A PLATFORM FOR COLLABORATION

In less than two years, Amsterdam Smart City has evolved into an alliance of partners that continues to grow.

Besides the partners that are involved in specific subprojects, the ASC platform also consists of a network of companies, local authorities and organisations that, in the future, could play an active role in any given subproject or component in terms of sharing knowledge and experience about smart cities. The platform currently consists of approximately 70 partners.

16 subprojects were initiated between 2009 and 2012 (still on-going) involving 36 “smart technologies”, regrouped within 4 different categories: Working, Living, Mobility and Public Space.

“We intend to make it possible by creating a powerful coalition of companies and knowledge institutions that will collaborate to roll out new infrastructure that will, in turn, facilitate the creation of new products and services.

ASC will continue to facilitate that process by creating new coalitions and by bringing parties together”

source: Smart Stories, ASC (2012)



IMPLEMENTING SMART CITY SOLUTIONS

THE WEIGHT OF PUBLIC INVOLVEMENT

Smart City initiatives need to leverage large volumes of capital to fund themselves (from \$10 bn for *PlanIT Valley* to \$35 bn for *Songdo*), and must then combine public and private sources of funding.

The public sector may have to provide for a significant proportion of funding through state-owned banks or direct financing. This was the case in *Masdar City*, *Nanjing Eco High-Tech Island*, *Meixi Lake*, China, and *Tianjin Eco-City*.

Conversely, *Songdo* and *PlanIT Valley* relied on investment and capital from international companies, with indirect support and tax relief being provided by government.

At any rate, public bodies have been involved to varying extents in Smart City initiatives, in capital structures which cannot yet be proven to be optimal, considering their recentness.

INVESTING IN REAL ESTATE DEVELOPMENTS

Most Smart City projects are first and foremost real estate developments: they rely mainly on real estate sales and rentals to eventually repay the capital providers. The reliance on this aspect, to procure secure revenue, must be coupled with strategies that actively attract businesses and residents to the Smart City.

PlanIT Valley is an interesting alternative, as property development is not the major driver of its business model. The initiative's business model is based on the software industry, and is comprised of revenue sharing arrangements, royalties for the use of intellectual property developed by the firms involved, annual partner fees, and *PlanIT Valley* participation fees.

TECHNOLOGY AS KEY DRIVER?

Smart City initiatives put cutting-edge technology at the forefront of their strategy, but are in fact differentiated in the extent to which this element is central to their development.

While *Dongtan City* has not yet recruited a technology firm to involve in its development, most Smart City initiatives include a technology provider in their partner firms.

Technological solutions are not always at the core of business model of Smart City initiatives, but they can, in some cases, be more heavily emphasised. This is the case in *Songdo* and

Meixi Lake, where Cisco implements its Smart + Connected Communities initiative, and in *Masdar City*, defined as "a test-bed for new technologies" including the use and application of smart sensors and city-wide power and utility management systems. Technology is the very foundation of *PlanIT Valley*: framed as a research city, it will showcase existing new and to-be-developed technology of *Living PlanIT* and its partners (including Cisco and McLaren Electronics).

SMART CITY REPLICATION: ESTABLISHING BEST PRACTICES

How can be successful Smart City initiatives be replicated? Being at an early stage of existence, Smart Cities are developed according to a great variety of institutional and financial arrangements. Some best practice cases can be identified, and Smart City developments all address the question of replicability.

China has been involved in a great number of Smart City initiatives, and has improved its institutional arrangements by learning from its early difficulties: from *Dongtan City* to the Sino-Singaporean initiatives, it relied less on public capital and brought in a more diversified set of organisations into the project.

Gale International and Cisco, initially involved in *Songdo*, have the explicit aim of scaling their development model and implementing it elsewhere. *Meixi Lake* is the first of many planned replicas of *Songdo*.

The replication of Smart City initiatives faces a number of challenges, which have to be addressed when planning future development models:

- Access to well-located, reasonably priced land is necessary, but not sufficient, condition;
- Urban development occurs in specific ways in different political systems;
- Lessons learnt from greenfield Smart Cities have to be applied to projects regarding existing cities or urban retrofitting;
- The economic foundation of the planned city has to be strategically devised, avoiding to rely solely on real estate per se. Promising sectors for Smart Cities include health care, light and heavy manufacturing, natural resources and tourism.

D

CASE STUDIES

CASE STUDY
SONGDO, SOUTH KOREA



SONGDO

Leading the way in the development of Smart Cities, Songdo, in Incheon, South Korea, is the world's most advanced project to date. This **\$35bn project** is located on 1,500 acres of reclaimed land on the coastline, and was driven on the opportunity to capitalise on the proximity to both Incheon's international airport (28.5 million passengers/year), and to Seoul (60 km away).

With a mix of LEED-certified residential, retail and office buildings, Songdo is structured around a Central Park of 100 acres, and overlooks the Incheon bay. Thanks to Incheon's Free Economic Zone's attractive business environment, Songdo has received investment from international companies as well as national champions such as Samsung: the company has invested \$1.8bn in a 274,000 m² bio-industry plant in the city.

The city is designed as dense and pedestrian-friendly, with all main venues within a 15-minute walk, and 30% of the city's land being allocated for parks and green space.

With a population of over 100,000 inhabitants, Songdo is expected to reach 300,000 by 2015, harnessing the momentum of its cutting-edge Smart City technology.

A SMART CITY PIONEER

Songdo's specificity relies on the state-of-art technology embedded in its urban design — it is deemed to be an 'ubiquitous city'.

All of the city's information systems are linked to each other, spanning across energy, water, waste management, transport and telecommunications, from city-scale to individual homes. The TelePresence system, built in every housing unit, offers control over lighting, air conditioning/heating systems, gas, curtains and all other home devices using touch-screen wall pads, remote controllers, smartphones and computers. TelePresence will enable real-time video communication and provide a window not just to family members, but also to a host of service providers such as schools, banks and the government.

Other high-end technological infrastructures include: a centralized pneumatic waste system, a water-cooled HVAC system, and district co-generation heating and cooling.

AN INTEGRATED NETWORK COMMUNICATION TECHNOLOGY

The provision of Smart City services and their integration across all areas of the urban experience relies on an

institutional architecture articulated around an international joint venture specifically set up: **New Songdo International City Development LLC (NSIC)**

The integration of the information systems across all areas of city life is bound together by network communication technology, under Cisco's technological leadership. Cisco has secured its position as Songdo's technology provider through an agreement with NSIC stipulating that it will invest in U.Life Solutions with NSIC, while holding a minority stake. In return, U.Life Solutions delivers Smart+Connected Community. This paves the way for Cisco to establish a Global Showcase for its smart city solutions.

U.Life Solutions will deliver the managed Smart City services over the Cisco Unified Service Delivery Platform, the single integrated solution unifying data centres, computing resources, video, collaboration and communications for Songdo.



A LUCRATIVE BUSINESS PLAN?

At a Cisco event near New Songdo last summer, Songdo's developer Gale International announced plans to eventually roll out 20 new cities across China and India, using New Songdo as a template. In the spirit of Moore's Law, he says, each will be done faster, better, cheaper, year after year.

Cisco estimates the Smart+Connected Communities initiative at a potential \$30 billion, a number based not only on the revenues from installation of the basic infrastructure but also on selling the consumer-facing hardware, as well as the services layered on top of that hardware.

CASE STUDY LAVASA, INDIA



“65% reduction in potable water consumption and 95% reduction of waste sent to landfill”

source: Lavasa Website

INDIA'S FIRST SMART CITY

Lavasa Corporation, Cisco and Wipro have signed agreements in 2010 to invest \$82 million (£54 million) in a joint venture company, **MyCity Technologies**, in order to provide information and communications technology services in the new development of Lavasa, soon-to-be India's first complete e-city.

The strategic collaboration between the three companies, to build a next-generation intelligent sustainable community, is based on a shared vision of sustainable urbanization, the Cisco Smart+Connected Communities initiative, also used in Songdo, and Wipro's ICT solutions and services.

While Cisco provides an open-architecture platform to deliver services, Wipro will provide its expertise in areas such as city management services, e-governance, ICT infrastructure and value-added services for the home.

MyCity Technologies

Lavasa Corporation	+	CISCO	+	Wipro
(developer)		(IT networks)		(ICT solutions)

LAVASA

Lavasa comprises 25,000 acres of Smart City developments near Pune, in the Indian state of Maharashtra. First hill station to be built in India after Independence, it will also be the country's largest when finalised in 2020. Dasve, the first of its five villages, has been completed in 2011, while Mogaon, the second village, is due to open in 2013. Lavasa's expected population is of 200,000 permanent residents.

Lavasa's masterplan fell to HOK, and includes, alongside residential and commercial developments, sport facilities, a theme park, a university, a health and wellness centre and a herb plantation. The development relies only on private sources of funding, the state of Maharashtra having supported the project solely through enabling legislation. The urban form advocated by HOK draws dense development toward the lake, while creating open public realm spaces.

The development's financial model is built on three pillars: real estate sales, city service revenues and joint ventures with niche companies. Each phase of the four-phase, \$30-billion development is staked to its own economic driver. Phase one is principally geared to tourism, conventions and higher education; phase two will target biotech and software industries.

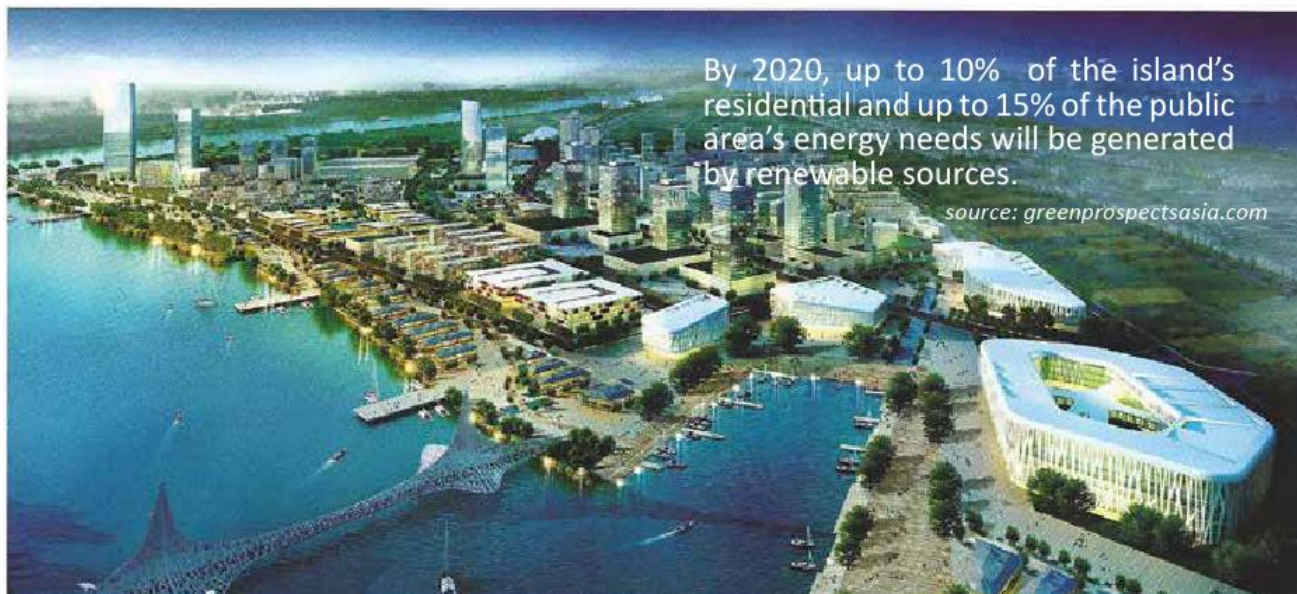
MYCITY TECHNOLOGIES

MyCity Technologies relies on a core ICT infrastructure (optic fiber network, structured cabling and passive infrastructure), and has undertaken a number of initiatives:

- The largest GPON-based network implementation in the country
- e-Governance and City Management Solutions:
 - Faster response from citizen services and anytime-anywhere access to information
 - Easy payment of all utilities and city-related services
 - Centrally monitored electronic security and surveillance
- Smart Homes and Digital Lifestyle Experience
- Centralised Data Centre to manage the city wide IT
- Ready-to-use High Speed Broadband, Wi-Fi and other services from Service Providers
- Electronic Security & Surveillance System
- Complete ICT Solution for Tourism, including a "tourist smart card"
- Tele-Medicine

CASE STUDY

NANJING ECO HIGH-TECH ISLAND, CHINA/ SINGAPORE



By 2020, up to 10% of the island's residential and up to 15% of the public area's energy needs will be generated by renewable sources.

source: greenprospectsasia.com

A SMART CITY WITH HIGH ECO-STANDARDS

Nanjing Eco High-Tech Island (Nanjing Ecocity) is a Chinese ecocity being developed by a joint partnership with Singapore. It is about two square miles in size and four miles from Nanjing, the capital of southern Jiangsu province. This ecocity's goal is "to establish a platform for the sustainable development of high-tech, smart industries under an ecologically conscious environment".

Although the island has a land area of 15.21 km², less than half or 7.15 km² will be developed while the rest will be preserved for ecotourism. The ecology planning system includes the use of renewable energy such as wind and solar power, non-traditional water sources, waste recycling and processing, green transportation through the use of trams and electric buses, green architecture, and landscape ecology.

A FINANCIAL COOPERATION BETWEEN CHINA AND SINGAPORE

In November 2007, a bilateral platform—the Singapore-Jiangsu Cooperation Council—was launched to promote collaboration between Singapore and Jiangsu on the project. International Enterprise (IE) Singapore signed a memorandum of understanding with the Nanjing Municipal People's Government agreeing to jointly undertake a feasibility study of the Eco High-Tech Island. The final agreement was formed in 2009, and the city is slated for completion in three phases by 2020. Three Chinese banks—Bank of China, Industrial and Commercial Bank of China, and

Bank of Shanghai— extended an RMB 7.2 billion credit line to the Singapore- Nanjing Eco High-Tech Island Joint Venture company.

PRIVATE PARTNERSHIPS UNDER PUBLIC LEADERSHIP

The Nanjing municipal government procured the land, and the real estate developers are Singapore Intelligent Eco Island Development and Nanjing Jiangdao Investment & Development Company.⁵⁵ Singapore Intelligent Eco Island Development is a private joint venture company formed by Yanlord Land Group (real estate developer), Sembcorp Industrial Parks (industrial development and engineering), and Surbana Land (design/architecture of the city). Other companies involved include G-energy Global, ST Engineering, Etonhouse International, AVI Tech Electronics, and Ivy Group (a Hong Kongbased firm that plans to develop educational systems for the city).

CURRENT STATUS

In October 2010, the Singapore-Jiangsu Cooperation Council was renewed for three years, to promote further "economic collaboration in urban planning and development, environmental services, logistics, commercial tourism/ hospitality projects." The council also announced in October 2010 that the official launch of housing construction for Nanjing Eco High-Tech Island had recently taken place.

CASE STUDY

LOW2NO, FINLAND

“With this project Sitra encourages cities and the real estate and building industry to tackle these ambitious goals in their projects”

source: Jukka Noponen, Ex. Dir. of Sitra's Energy Programme

A SMART, SUSTAINABLE DEVELOPMENT IN FINLAND'S CAPITAL CITY

Low2No plans to be a mixed-use eco-development in Helsinki, about the size of a large city block. In 2006, a master plan for the redevelopment of Jätkäsaari, an industrial port area, was approved, and the Low2No site lies within this region. Low2No's goal is to create a successful prototype of a low- to no-carbon district. The project intends to “spur innovation in the field of energy efficiency and sustainable development.” The project does not expect to make a profit; its primary goal is to catalyse sustainable development in Finland by learning from the project and enacting new financial policies to make low carbon ventures economically viable. The development's leaders hope this will encourage other developers to tackle similar projects in the future.

SITRA'S FINANCIAL INVOLVEMENT, UNDER GOVERNMENT SUPERVISION

Unique because of its innovative financing model and partnerships, Low2No was initiated by Sitra, Finland's government-run venture capital fund and investment firm. Sitra is supervised by the Finnish Parliament, and its projects are funded by endowment capital and returns from capital investments. Sitra's tasks are to promote the welfare of Finnish society through stable and balanced development in the growth of the country's economy. Sitra has identified energy and low-carbon development as a major area of interest. A team led by international design and engineering firm Arup won a competition in 2009 to design the Low2No carbon neutral district.

SITRA'S PARTNERS FOR LOW2NO

Other members of the winning team included international sustainable finance consultancy Galley Eco Capital, architecture firm Sauerbruch Hutton, and design consultancy Experientia. Sitra partnered with SRV, one of the biggest real estate developer in Finland, and VVO, the Finland's largest provider of rental buildings, to develop the project. SRV and VVO are traditional companies focused on the bottom line of building sellable developments while Sitra is focused on transforming Finnish industry and spurring clean tech and economic development. SRV and VVO do, however, aim to become leaders in sustainable construction and residential development.

All decisions for Low2No have input from multiple project partners and are made through a five-frame “lens” which includes Inspired Design, Social Innovation, Environmental Responsibility, Economic Viability, and Replicability/Diffusion.

LOOKING AHEAD

After the design competition, Sitra moved on to planning and scoping phases focused on the project proposal and general project guidelines such as sustainability frameworks and carbon protocols. The government hopes to see the completion of ten successful low or zero-carbon developments similar to Low2No in the five years after Low2No is complete. Sitra plans to use the number of these developments as one metric of the project's success.

CASE STUDY

PLAN-IT VALLEY, PORTUGAL



A RESEARCH CITY WITH A CENTRAL “BRAIN”

PlanIT Valley is a prototype smart city being planned for a site in the municipality of Paredes, about ten miles from the center of Porto, Portugal, by a start-up high technology company called Living PlanIT. In 2008, the company acquired the right to purchase 4,200 acres from the municipal government of Paredes as the site for PlanIT Valley.

PlanIT Valley was designed as a research-focused city in which Living PlanIT and its partner companies would base research and development operations to test new technologies and services for sustainable urban development.

PlanIT develops an “Urban Operating System” (UOS). The UOS is intended to function as the city’s central “brain” by collecting information from all urban systems, storing it in the UOS data center, and efficiently managing the systems through a software platform.

A PRIVATE PROJECT, BACKED BY GOVERNMENT SUPPORT

Living PlanIT is running the project, which received special investment status from the Portuguese government as a “Project of National Interest”, an asset valued at €8 million on the company’s balance sheet. The initiative also benefits from strong support from all levels of the Portuguese government including the Municipality of Paredes and various national agencies in Lisbon. The city aims to be green and has extensive plans for alternative energy usage and water/energy efficiency, as well as a goal of diverting 80% of trash to energy production or recycling (in comparison to the current average of 5% per city). Living PlanIT plans to build pre-made smart infrastructure technology and sensors into all the city’s facets—from concrete foundations blocks to the energy supply to transportation systems. The total expected cost of this venture is \$8 billion to \$10 billion.

Living PlanIT and its partner eco-system plan to develop several revenue streams to fund the Valley. Living PlanIT estimates the revenue produced from real estate leases in PlanIT Valley will represent less than 5% of total revenues. Revenue streams, such as partner fees, participation fees and equity sharing, are planned to be supplemented with small amounts of debt capital from banks. The conversion of \$8 million worth of salaries to employees to equity means that venture capital funding has not been needed to date.

AN ECOSYSTEM FOR PARTNERSHIP AND COLLABORATION

PlanIT Valley’s business model depends on “creating an ecosystem of large and small company partners that will focus on creating products and services for sustainable urbanization.” It has already established partnerships with companies, including Cisco, Accenture, U.K. engineering firm Buro Happold, and McLaren Electronic Systems, which manufactures sensors. The goal is for these companies to work together in PlanIT Valley to develop city-solution technologies and the UOS platform, and to tackle similar city-building projects elsewhere.

“WAVES” TOWARDS COMPLETION

Land acquisition and zoning for the commencement of construction were underway in 2010. PlanIT Valley has been divided into 25 “Waves,” with the first Wave involving the purchase of 90 acres of land and the building of R&D centers, schools, and retail, residential and entertainment facilities, expected to be completed by the first quarter of 2012. The project’s target goal was to have the majority of PlanIT Valley completed by the end of 2015, by which time the city plans to accommodate around 150,000 residents.

CASE STUDY SMART SANTANDER



ENTIDADES COLABORADORAS



MOstrar AVISOS

EL DIARIO MONTAÑÉS

☐ NOTICIAS

SANTANDER AUMA

☐ AGENDA CULTURAL

AUTOBUSES SANTANDER

☐ AUTOBUSES

PARTICIPACIÓN CIUDADANO

☒ AGUAS

☒ FUGA

☒ ATASCO EN ALCANTARILLA

☒ CORTE DE SUMINISTRO

A TESTBED FOR IoT

The city of Santander, on the north coast of Spain, is home to 200,000 people. Two years ago, it began a campaign to roll out cutting-edge communication technology throughout the city and its suburbs, installing 12,000 sensors to gather all useful information on municipal activities and facilities and send relevant data to a central platform.

Smart Santander aims at providing a European experimental test facility for research and experimentation on architectures, key enabling technologies, services and applications for the Internet of Things (IoT) in the context of the smart city. Common urban platform

SMART SANTANDER: A PPP

Smart Santander is a PPP between Santander local authorities and private companies such as Telefonica and IBM. The initiative covers a wide range of projects such as: Traffic management (parking control, bus stops, loading/unloading areas), Irrigation optimization in parks and gardens, Augmented reality, Public street lighting, Waste management.

The actions are structured around (1) building a common Urban Platform, (2) creating an Open innovation Lab (access to data), (3) ensuring an Integral service management (horizontal integration), (4) incorporating IoT technology in the urban services.

PULSO DE LA CIUDAD

Pulso de la ciudad allows citizens to report events happening in the city and problems in public spaces. The information are immediately shared to the relevant departments; the response rate for a typical issue went down from 3 weeks before the system to 6-7 days.



CASE STUDY

CIUDAD CREATIVA DIGITAL, MEXICO



MEXICO'S FUTURE TECH HUB

"CCD aims to be a 21st century place of creative work and culture that will build upon the unique qualities of downtown Guadalajara- transforming the city into one of the world's leading centers of digital creation."

CCD will be a place to work in leading edge digital creative services, but also a physical smart city with a highly interactive, sustainable built environment. A range of digital technologies will be embedded in the urban fabric, offering citizens and businesses differentiated live/work experiences and helping foster the growth of future media enterprises.

CCD in Guadalajara will become a place where digital technology allows increased efficiency, helping to save energy and better manage precious resources, such as water.

The same technologies will also improve productivity at work by bringing people together in the virtual and physical space."

Extract from CCD Brochure

"Imagine combining Silicon Valley entrepreneurship with Mexico's unique culture and traditions. Digital media creativity with outdoor working environments of unparalleled lifestyle.

The new magnet for the global creative class; that's what Guadalajara is set to become through the Ciudad Creativa Digital."

Carlo Ratti, Director, MIT Senseable City Lab



CONCLUSIONS

SUMMARY

SMART CITY KEY POINTS

• SMART CITY: EXPLOITING DATA AND CONNECTIONS FOR BETTER EFFICIENCY

In cities, all individuals, organisations and activities are interconnected by a multitude of flows of information. Cities generate a considerable volume of data, still largely untapped in traditional urban planning and management.

Smart Cities make use of ICTs to enhance our understanding of the production of urban data, and exploit it to deliver societal, economic and environmental value.

• A SMART CITY FOR A CONTEMPORARY LIFESTYLE

Recently technological milestones have altered the dynamics within our cities so profoundly that some believe the movement rivals the changes brought on by the Industrial Revolution. The way we work, we socialise, we play, etc. is changing rapidly and smarter cities can adapt and build on such dynamics to create new services, adapted to the contemporary lifestyles of its citizens.

• SMART CITY AS A DRIVER OF INNOVATION

The information that flows between systems implemented as part of a Smart City development leads to the delivery of added-value to cities and customers, and drives innovation. Cities can now treat their digital infrastructure and the “big data” it contains as a market creation asset that can create new jobs, drive costs down, generate significant benefits for their citizens and promote digital industries within their regions.

• NOT ONE ‘OFF THE SHELF’ SOLUTION

There is no “off the shelf” smart city solution which can be stamped onto all urban development projects. A careful scoping of such solutions and “future scenarios” should be undertaken to select solutions with the highest returns within the specific context of a project. Furthermore, the implementation and governance of smart city solutions have to be carefully crafted within bespoke roadmaps:

- Who provides the funding?
- How is it governed?
- Who owns the networks and data?
- Who should be able to exploit this data?

• A MOBILISING CONCEPT FOR ALL STAKEHOLDERS

Besides the development and integration of new and smart technologies in a Smart City system, the Smart City requires new modes of governance to be developed. These must be less ‘top-down’ than traditional governance policies and instead focus on more horizontal governance solutions which spur collaboration and networking between different stakeholders. The Smart City concept is a useful mobilising tool to bridge the gaps between public and private actors.

• AN OPPORTUNITY FOR DISTINCTION

The Smart City concept can be a vehicle for an ambitious vision for a city; fully integrating a Smart City scenario with city branding can help to shape a distinct image, provide unique services and give a competitive edge in attracting visitors, businesses and new residents.

• EMPOWERING CITIZENS AS AGENTS OF CHANGE

Smart City does not encompass one single reality: it is an urban development strategy which drives constant innovation. In this process, citizens should be considered as the main agents of change to utilize data, optimize their travels and raise their awareness about consumption of resources.

Smart Cities provide the conditions and resources for change; it is an urban innovation ecosystem which will ensure a future-proof development of the city.

• FITS GREENFIELD DEVELOPMENTS

From the technological perspective in existing cities, the biggest challenge is to re-engineer existing technologies and to develop new ones which are able to function together in systems. This retrofitting process can be a complex and costly initial stage; greenfield developments are therefore prime candidate for state-of-the-art smart city solutions.

