Smart Sustainable Cities - Reconnaissance Study

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Smart Sustainable Cities

Reconnaissance Study

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Executive Summary

The global urban population is expected to grow by 63 percent between 2014 and 2050 – compared to an overall global population growth of 32 percent during the same period. Megacities with over 20 million inhabitants will see the fastest increase in population – and at least 13 new megacities are expected by 2030, in addition to the 28 existing today. The fastest growing urban centres contain around a million inhabitants, and are located in the lower-middle-income countries in Asia and Africa.

The anticipated growth of cities creates unprecedented sustainability challenges. Increasing demands for energy, water, sanitation, education, healthcare, housing, transport and public service are testing the limits of city infrastructures. In 2015, 828 million people lived in temporary housing that lack basic services like sanitation and access to drinking water. Six million new people move to such housing every year, thus ever increasing the demand for services. Cities are responsible for 67 percent of the global energy demand and consume 40 percent of world's energy overall. Urban centres are responsible for 70 percent of global greenhouse gas emissions, contributing to climate change. In addition, urban centers increasingly experience natural disasters. They can also witness social tension brought on by rising inequality and unemployment, air and water pollution, traffic congestion, and urban violence and crime.

At the same time, urban centres offer tremendous opportunity for economic development. Eighty percent of the world's gross domestic product is generated in cities. Urban citizens earn on average three times the income of their rural counterparts. Cities have a concentration of universities and are critical venues of research and innovation, political activism and cultural exchange. People living in larger cities tend also to have a smaller energy footprint, require less road and communication infrastructure, consume fewer resources, and have higher productivity levels. For example, according to earlier research, a city of eight million has 15 percent more productivity, e.g. wages and patents produced per capita, and 15 percent fewer infrastructure needs, e.g. gas stations, electric wires and roads, than do will two cities of four million each.

Smart Cities have emerged as one response to the challenges and opportunities created by rapid urbanization. This report presents the results of a reconnaissance study examining the thesis that Smart Cities advance sustainable development. The study analysed 876 scientific publications, recommendations from 51 think tank organizations and 119 concrete Smart City initiatives. Researchers also conducted seven interviews with city managers, planners and researchers responsible for successful Smart City initiatives.

Smart Sustainable Cities

There are different digital technology models for cities, from Digital Cities to Intelligent Cities to Smart Cities, which are incorporated according to the degree and nature of digital technology capacity of the city. Digital Cities integrate digital technology into the city's core infrastructure systems, while Intelligent Cities rely on the Digital City infrastructure to build intelligent buildings, transportation systems, schools, enterprises, public spaces, and public services, and integrate these into intelligent urban systems. Smart Cities deploy intelligent urban systems to serve socio-economic and ecological development, and to improve quality of life and address the origins of social instability in cities.

The Smart Sustainable City – the concept advanced in this report – best realizes the benefits of Smart Cities as it focuses on a continuous transformative process, based on stakeholder engagement and collaboration, and building different types of human, institutional and technical capacities. In this model, the city contributes to improving the quality of life of its citizens by pursuing socio-economic development and protecting natural resources among other locally-defined priorities.

The study learned for instance that Smart City initiatives can help overcome the limitations of traditional urban development that tends to manage urban infrastructure systems in silos. The siloed system leads to poor information sharing between systems, functions and stakeholders, such as citizens, businesses, government and civil society organizations. Smart City initiatives leverage data and services offered by digital technologies, such as cloud computing, open data sets, or the Internet of Things to help connect city stakeholders, improve citizen involvement, offer new or enhance existing services, and provide context-aware views on city operations. A city-wide digital infrastructure can help integrate different urban infrastructure systems including energy, water, sewage, or transport, and enable efficient management, control and optimization of such systems. These initiatives also address environmental and human-capacity issues.

Smart City development is at the same time highly complex and challenging. The integration of urban systems into one “system of systems” capable of self-adaptation and self-management is difficult. There are constraints on system interoperability and reuse of data, and heterogeneous sources of quantitative and qualitative data provided by open government, citizen science and other projects and low capacity for connecting data to analytical models. Smart Cities raise serious concerns related to citizens’ privacy, government surveillance and other digital rights. There are also other issues with connecting urban sustainability challenges to actionable approaches, social and territorial cohesion issues requiring unique governance solutions, and the different discourse used by technologists and policymakers. In the end, it is critical that Smart Cities are not driven by particular ideological positions or commercial interests, but rather embrace public value in all economic, social, ecological, and political dimensions.

This study discovered a wide variation of Smart City initiatives in different geographic locations. There are Smart City initiatives in both developed and developing countries, and Europe leads the way with 37 percent of initiatives found followed by Asia Pacific (28%), Africa (13%), North America (13%), and Latin America and Caribbean (9%). Most Smart City initiatives (25%) focused on Smart Living, i.e. how digital technology enables healthy and safe lifestyles; Smart Environment (21%), e.g. technology-enabled energy grids, waste management and other initiatives for reducing pollution; and Smart Economy (19%), e.g. technology-enabled production and delivery of products and services; and less on other initiatives, such as Smart Mobility (13%), i.e. technology-enabled and integrated transport and logistic systems; Smart Governance (13%), i.e. technology-enabled policy and governance processes; and Smart People (9%), e.g. people with e-skills, working on technology-enabled jobs. The majority of initiatives focused on one (40%) or two (24%) objectives and a few (8%) tried to balance all six objectives. The majority of initiatives (66%) are implemented by governments, followed by industry (19%) and NGOs (15%). Most were concerned with planning (60%), and the rest by implementation (40%). Interestingly, despite the discourse in the literature that contrasts top-down and bottom-up initiatives, it is clear that top-down or government-led initiatives (83%) are dominant, while only 17 percent are bottom-up or citizen-driven.

Smart Sustainable Cities in Developing Countries

Smart Cities have a lot of potential to improve the circumstances of developing countries. Yet given the relative newness of the concept, this potential is not fully realized in most developing countries. Several existing trends and structural factors could actually widen the gap between potential and reality:

- Weak research capacity hinders the contextualization required for Smart Sustainable City initiatives in developing countries. Smart City research is primarily conducted in developed countries: only 12 percent of the most published researchers are from developing countries, 33 percent of the most productive Smart City research institutions are in developing countries, only 13 percent of the countries leading Smart City research are developing countries.
- Smart City policy work is also primarily conducted in developed countries, with most policy organizations based in the United States (37%) and United Kingdom (14%), and only eight percent in developing countries like Chile, China, India or Russia. The lack of indigenous policy organizations means that developing countries tend to adopt policy frameworks provided by and tested in developed countries, which is not optimal for different country contexts and risks advancing the interests of provider countries over local interests.
- Developing countries tend to pursue Smart People and Smart Governance dimensions less - arguably the areas of their most pressing need. The study found that Smart City developments in developing countries typically pursue Smart Environment, Smart Living and Smart Economy dimensions instead.
- Locally driven non-governmental organizations (NGOs) are important to balance commercial interests and deliver sustainable benefits to people, but according to the study developing countries have half the number of NGOs that developed countries have participating in Smart City initiatives.
- Developing countries have a two to one planning to implementation ratio among its Smart City initiatives, in contrast to the one to one ratio in developed countries. This highlights a need for research to inform Smart City planning in developing countries.
- Smart City initiatives in developing countries are typically top-down (government-led) rather than bottom-up (citizen-driven), constituting a potential issue with local relevance and sustainability.

Research Agenda

In order to realize the vision of the Smart Sustainable City, we propose a research agenda that adapts general knowledge to specific urban contexts, learns from application experience to improve general knowledge, and enables a transfer of applications between urban contexts:

- Research problems must be policy relevant, address existing gaps or solve policy demands, apply multiple views to the issues at stake, and rely on available data and evidence to formulate findings.
- Research should relate to at least two of the four p's: people (e.g. citizens, governments, NGOs), problems (e.g. reducing commuting times), programs (e.g. urban regeneration) or phenomena (e.g. social polarization). Questions should examine whether a given problem affects a group of people, look at how a program solves a given problem, or analyse how a phenomenon produced by a given program affects a group of people. For example, research could assess the effectiveness of electronic surveillance in public spaces (program) for improving the safety (problem) of citizens (people).
- Research problems should also relate to the intersection of the urbanization, digitization or sustainability, e.g. address particular urbanization issues through digital technology; or ensure social, economic and ecological sustainability in urban planning; or digitize an urban service delivery system to advance its sustainability. Example: design an e-learning platform (digitization) that helps citizens (sustainability) participate in urban planning (urbanization).

Smart Sustainable City research is inherently multi-disciplinary but could stand to branch out. Currently, it is mainly driven by technical disciplines like computer science (36%), engineering (22%) and mathematics (7%), though contributions from non-technical disciplines such as social sciences (10%), business, management and accounting (6%), and environmental science (4%) are on the rise.

Policy Recommendations

Following are a series of policy recommendations for Smart Sustainable Cities:

- There are no off-the-shelf solutions for Smart Sustainable Cities. Every solution must to be adapted to and validated in the local context, and any strategy for implementing the Smart Sustainable City vision must be formulated and owned by the main city stakeholders. The vision should not focus merely on technological development, but also highlight improvements in the economic, social, cultural, ecological, and governance dimensions. Leveraging social and cultural changes introduced by the Smart Sustainable City transformation is an opportunity to instil civic values in the society.
- As cities have different levels of maturity for different dimensions, the strategy should include having stakeholders agree on priority areas. Strategies should also be informed by the “urban metabolism”, i.e. how the city produces, transforms and consumes materials, energy, capital and other resources. Transformation should progress within and across these dimensions, and while progress is made in one dimension, it should not deteriorate in another.
- Smart Sustainable Cities require a two-pronged approach: top-down (government-led) to build foundations, and bottom-up (community-driven) to conduct local sector-specific initiatives, such as delivering innovative services by local Small and Medium Size Enterprises (SME) based on open data.
- Government’s responsibility is to promote and stimulate bottom-up innovation. Measures could include living labs for co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios and concepts, as well as testing technological instruments and artifacts in various real life usage scenarios.
- Smart Sustainable Cities should include open government initiatives to ensure access to government data, to increase participation and to leverage innovation through public service co-creation. They should also rely on open, centralized and collaborative approaches to public and non-public service delivery.
- To further the sustainability in Smart Cities, knowledge sharing platforms should be in place to promote good practices related to governance, transport, water, sewage, electricity, mobility, environment, urban planning, social cohesion, quality of life, citizen participation, digital infrastructure, and contextualization.

All of these recommendations require awareness of local context, policy and technical alternatives, and policy-relevant research to evaluate and decide among alternatives.

According to the United Nations, sustainable cities will be a major engine for pursuing the Sustainable Development Goals. As neither national, nor city governments can pursue such goals alone, urban sustainability is a major policy challenge for all levels of government. Any approach to addressing this challenge should utilize the potential of digitization to realize the vision of Smart Sustainable Cities.

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Abbreviations

ADR	Action Design Research
ADTV	Advanced Database TV
AFC	Automated Fare Collection
ANRE	Agency for National Resources and Energy, Japanese Government
API	Application Programming Interface
APP	Academia-Private Partnerships
ASC	Amsterdam Smart City
BCIS	Battery and Charger Integration System
CASA	Centre for Advanced Spatial Analysis
CCD	Ciudad Creative Digital
CERCI	Centre de Recherche sur les Communautés Intelligentes
CISE	Center for Informations & System Engineering
CITIES	Centre for IT-Intelligent Energy System in Cities
CPS	Cyber-Physical System
CRIC	Centre for Research and Information on Consumption
CRM	Customer Relationships Management
CSD	Centre for Sustainable Development
CUSP	Center for Urban Science + Progress
DESA	Department of Economic and Social Affairs
DF	Distrito Federal
DNA	Deoxyribonucleic Acid
DRAS	Demand Response Automation Server
DSR	Design Science Research
EADIC	Developing Enterprise Architecture for Digital Cities
EC	European Commission
EU	European Union
GAP	Government-academia Partnerships
GDP	Gross Domestic Product
GIFT	Gujarat International Finance Tec-City
GIS	Geographical Information System
GPS	Global System Position
IBM	International Business Machines
ICF	Intelligent Community Forum
ICIT	Centre for Sustainable Communications – ICT for Sustainable Cities
ICT	Information and Communication Technology

IDA	Infocomm Development Authority of Singapore
IDECA	La Infraestructura de Datos Espaciales para el Distrito Capital
IDRC	International Development Research Center
IEC	International Electro-Technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFTF	Institute for the Future
IMS	IP Multimedia Subsystem
INTELI	Inteligência em Inovação
IOCC	Smart City Integrated Operating Control Centre
IoT	Internet of Things
IPv6	Internet Protocol version six
ISO	International Organization for Standardization
ISP	International Service Provider
IT	Information Technology
ITU	International Telecommunications Union
IvT	Innovation Technology
KOICA	Korea International Cooperation Agency
KPI	Key Performance Indicators
MAC	Metro Atlanta Chamber
MANETS	Mobile Ad-Hoc Networks
MICE	Meetings, incentives, conferences, and exhibitions
MIIT	Ministry of Industry and Information Technology
MIT	Massachusetts Institute of Technology
MOHURD	Ministry of Housing and Urban-Rural Development
NCB	National Computer Board
NDRC	National Development and Reform Commission
NGO	Non-Governmental Organization
NYC	New York City
OECD	Organisation for Economic Co-operation and Development
PPP	Public-Private Partnerships
PPPP	Public-Private-People Partnerships
R&D	Research and Development
RFID	Radio-Frequency Identification
SCEA	Catalan Society for Environmental Education
SCID	Smart City Initiative Design
SCMM	Smart City Maturity Model
SCRAN	Smart Cities (inter)Regional Academic Network
SD	Sustainable Development
SEC	Singapore-ETH Centre
SGIX	Singapore Internet Exchange
SLR	Systematic Literature Review
SLS	Service Level Agreement
SMART	Singapore-MIT Alliance for Research and Technology
SME	Small Medium Enterprises

SPIE	Proceedings of the International Society for Optics and Photonics
SSC	Smart Sustainable City
SSTEC	Tainjin Eco-City Investment and Development Co., Ltd
UCL	University College London
UCP	Universitat Politècnica de Catalunya
UK	United Kingdom
UNDESA	United Nations Department of Economic and Social Affairs
UNU	United Nations University
UNU-EGOV	UNU Operating Unit on Policy-Driven Electronic Governance
URBS	Urbanização de Curitiba S.A
URENIO	Aristotle University of Thessaloniki Urban and Regional Innovation Research
USA	United States of America
V2I	Vehicle to Infrastructure Communication
V2V	Vehicle to Vehicle Communication
VGI	Volunteered Geographic Information
WCN	World Cities Networks
WIMS	Web Intelligence, Mining and Semantics
WSN	Wireless Sensor Network

1. Introduction

The rapid urban population growth taking place since the beginning of the last century creates unprecedented challenges for city governments and city residents alike; every second, the global urban population increases by 2 people (UNDESA 2015), cities account for 67% of the global energy demand (The World Bank 2014) and are responsible for up to 70% of the harmful greenhouse gases emissions (UN-HABITAT 2011). The population growth creates challenges on city infrastructure, on services like water, energy, transport and other, and on the management of the infrastructures and services.

Local governments are attempting to address the challenges of rapid urbanization through digital technology-enabled urbanization models, aimed at transforming cities to offer better services to residents and visitors. The approaches to such transformation have been evolving in the last years, from merely focusing on the deployment of technology to enhance service delivery, to improving the quality of life of urban residents through new technologies. Following the latter, the concept of Smart City has emerged, and Smart City initiatives are being implemented by many cities around the world.

The aim of this report is to explore the benefits, challenges and possible routes for Smart City innovations to further Sustainable Development objectives (called Smart Sustainable City in this report) in different local situations including institutional, socio-economic, political and cultural environment. Specific objectives pursued include:

- Present the findings of research and policy literature reviews, as well as interviews with experts and practitioners who advance the Smart City concept in various development context, with a focus on, but not limited to developing countries.
- Identify and describe a set of case studies where Smart City innovations are employed in different Sustainable Development situations.
- Build an inventory of key Smart City implementations in developing countries, and actors involved in such implementations and research in developing countries.
- Propose and justify a set of policy alternatives and related research questions to inform the choice of different options that should be addressed in short- to medium- term in order to advance Sustainable Development objectives through Smart City.

In order to fulfill these objectives, a rigorous methodology was defined, including 1) research and policy literature reviews through quantitative and qualitative analysis based on narrative reviews of scientific publications and policy documents; 2) assessing the state of practice based on quantitative analysis of Smart City initiatives, and qualitative analysis of case studies and interviews with experts; 3) synthesizing the findings of the research and policy reviews and case study development into a conceptual framework for Smart Sustainable Cities; and 4) providing policy recommendations and a research agenda.

The main contributions of this work include: the findings from the quantitative analysis of Smart City research, including identification of researchers and think tanks, and locations where Smart City research is being conducted; identification of policy instruments and tools for Smart City initiatives; a repository of Smart City initiatives conducted by city governments from around the world to address Sustainable Development issues; a conceptual framework including instances for each construct of Smart Sustainable City; policy recommendations to advance Smart Sustainable City innovations; and a framework for defining a research agenda and populating this agenda with illustrative research problems.

The rest of the report is organized as follows. Section 2 presents background concepts. Section 3 explains project methodology. Section 4 introduces the research literature review. Section 5 describes the policy literature review. Section 6 analyzes Smart City initiatives and develops them into case studies. Based on the findings from the research and policy literature reviews and the lessons learnt from the case studies, a conceptual framework for Smart Sustainable Cities is introduced in Section 7 based on which policy recommendations are provided in Section 8 and a research agenda is outlined in Section 9.

2. Background

This chapter presents the background to the concepts of Smart Sustainable City explored in this report. In particular, it introduces the urbanization trend in Section 2.1, Sustainable Development Goals related to urbanization in Section 2.2, and how digitization gives rise to Digital Cities, Intelligent Cities and Smart Cities in Section 2.3.

Figure 1 depicts the content of this section and the whole report at the intersection of the Urbanization, Sustainability and Digitization domains. In particular, Section 2.1 concerns the Urbanization domain, Section 2.2 concerns the intersection of the Urbanization and Sustainability domains, Section 2.3 discusses the intersection of the Urbanization and Digitization domains, and the whole report concerns the intersection of all three domains.

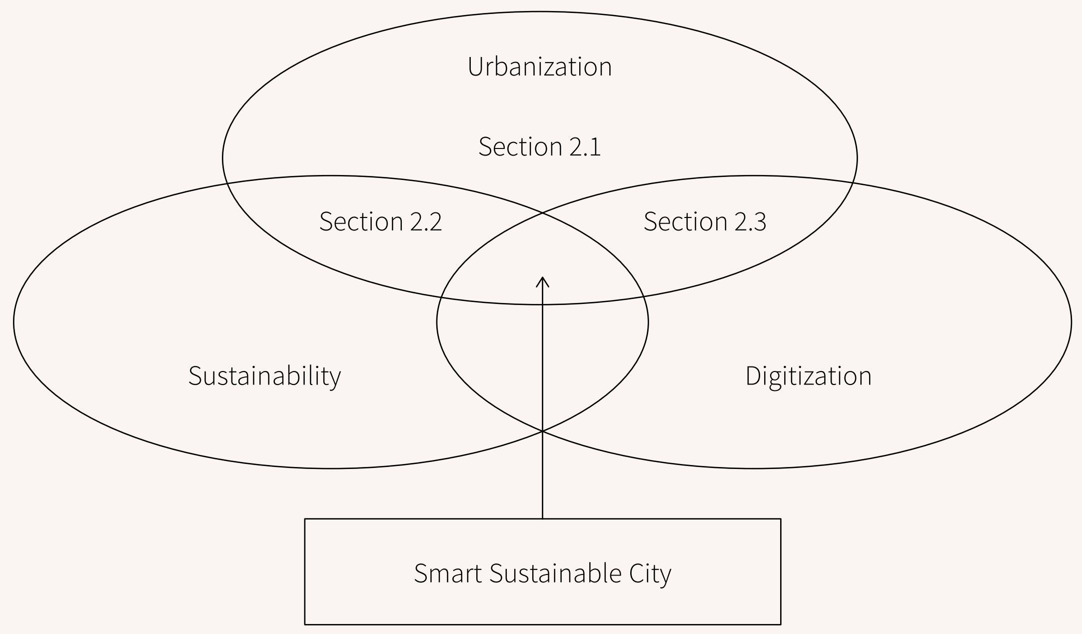

Figure 1: Urbanization, Sustainability and Digitization Domains

2.1. Urbanization

The aim of this section is to introduce the urbanization trend. To this end, Section 2.1.1 presents some figures about the urban population growth, Section 2.1.2 provides data about the growth of the world's cities and Section 2.1.3 discusses urbanization challenges.

2.1.1. Urban Population Growth

Since the last century and particularly since the industrial revolution when people started to move to cities as a consequence of the shifts in major economic activities from agriculture to manufacturing to services, the world is experiencing a very fast urbanization process. While agricultural communities are usually rural and dispersed, since farmers need land for growing crops, industrial and post-industrial communities tend to live in densely-populated urban areas since manufacturing and service industries need suppliers and customers to produce and consume their products and services.

The percentage of population living in urban areas in Europe increased from 10.9% in 1800 to 32.8% in 1910; and in Australia, Canada, New Zealand and the USA it increased from 5.5% to 41.6% (Bairoch and Goertz 1986) as shown in Figure 2. In 2008, for the first time in human history most of the human population lived in cities (UNDESA 2014b).

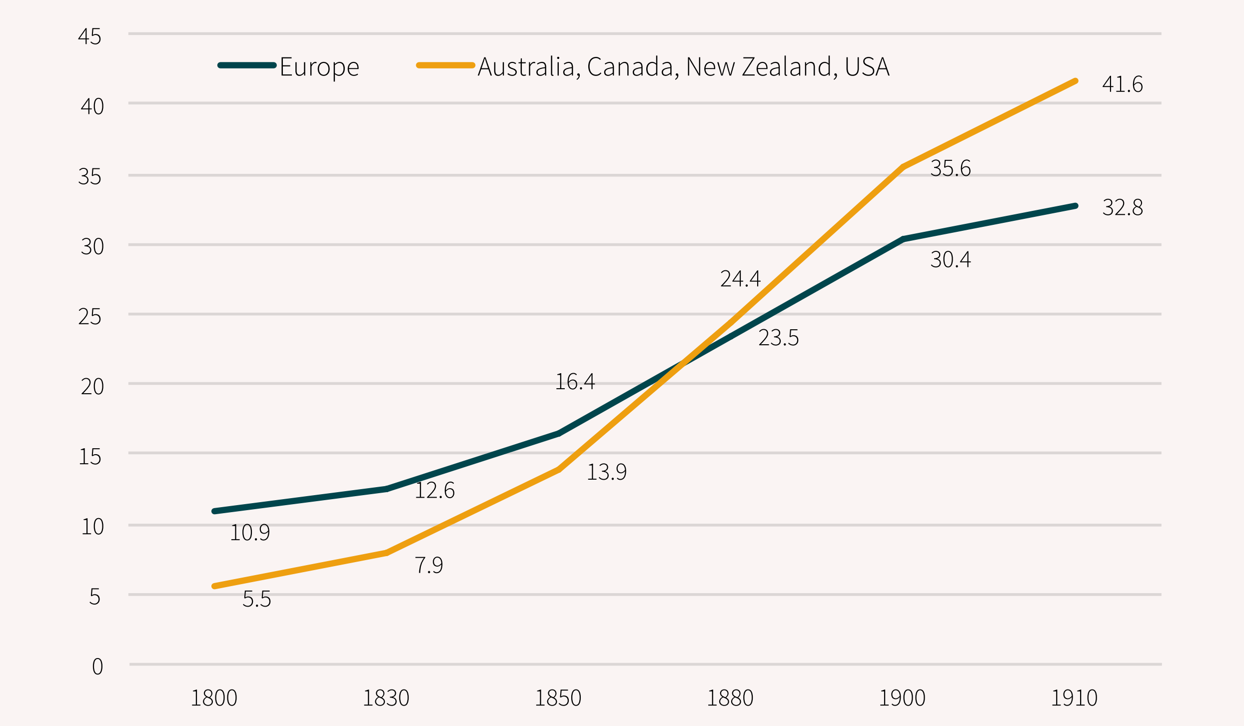

Figure 2: Urban Population Growth in Developed Countries

Following this trend, the urban population is expected to continue growing in the next decades. The United Nations forecasts that between 2014 and 2050 the world population will grow by 32%, i.e. from 7.2 to 9.6 billion (UNDESA 2007) while the urban population will grow by 63%, i.e. from 3.9 to 6.3 billion. As shown in Figure 3, the growth is expected to occur in developed, less developed and the least developed regions of the world (UNDESA 2014b).

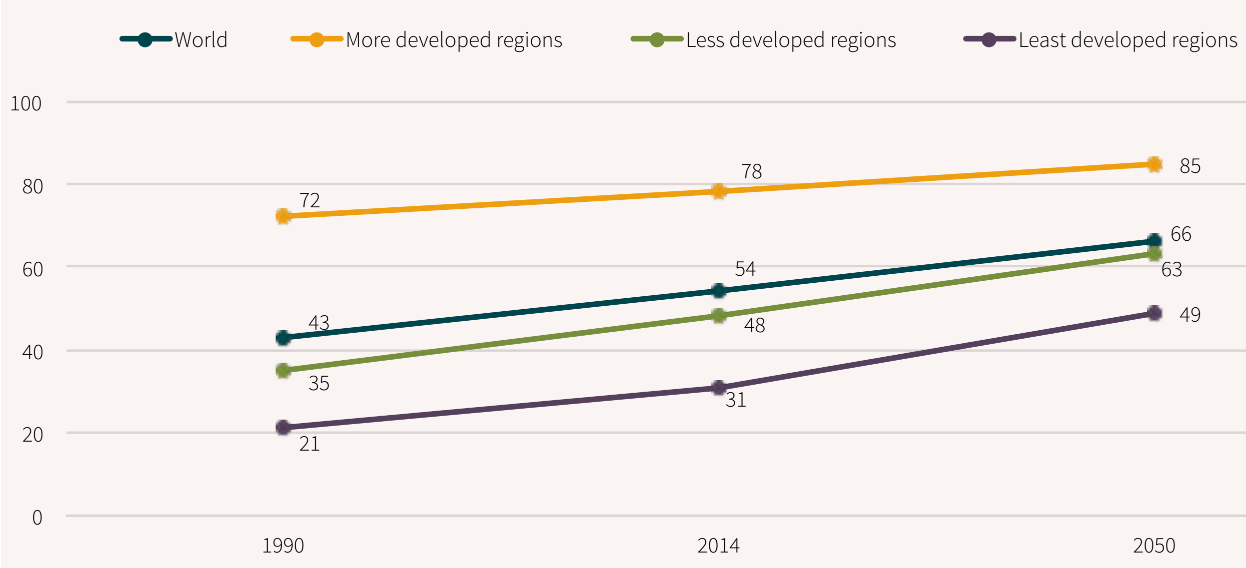

Figure 3: Urban Population Growth in all Countries

In particular, poor, traditionally rural regions in Africa and Asia are becoming urban societies at a faster rate than the rich regions in Europe and North America (UNDESA 2013). The regional trend is depicted in Figure 4, with Africa and Asia expected to make the biggest advancement in the world towards urbanization between 2014 and 2050.

URBAN POPULATION	2014	2050
Africa	40%	56%
Asia	48%	64%
Europe	73%	82%
Latin America	80%	86%
North America	81%	87%

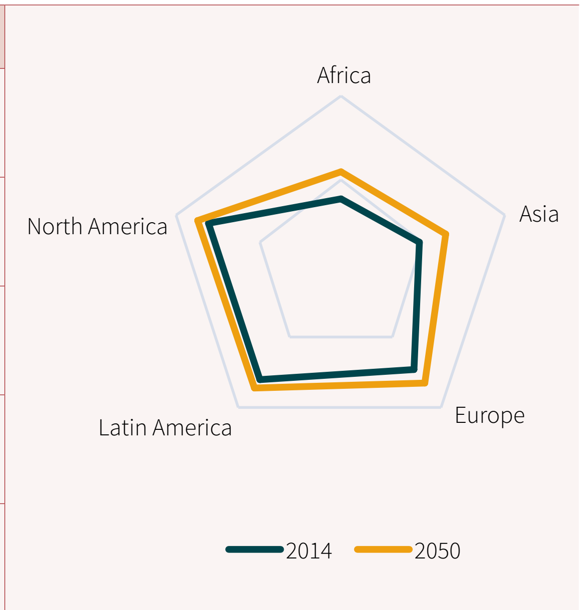

Figure 4: Urban Population Growth in Regions of the World

Table 1 presents some facts and figures related to urbanization (UNDESA 2014b).

Table 1: Urbanization Facts and Figures
○ The world's urban population grew from 746 million in 1950 to 3.9 billion in 2014.
○ In 2014, 54% of the world's population lives in urban areas.
○ Despite the low levels of urbanization, Asia hosts 53% of the world's urban population, followed by Europe at 14%, and Latin America and the Caribbean at 13%.
○ 37% of the world's urban population growth between 2014 and 2015 will be due to: India at 404 million, China at 292 million and Nigeria at 212 million new urban residents.
○ The fastest growing urban agglomerations are cities with less than 1 million inhabitants located in Asia and Africa.
○ Close to half of the world's urban population lives in cities of less than 500,000 inhabitants.
○ One in eight of the world's urban citizens lives in one of the 28 mega cities with more than 10 million inhabitants.
○ By 2030, the world is projected to have 41 mega-cities with more than 10 million inhabitants.
○ As the world continues to urbanize, Sustainable Development challenges will be increasingly affecting cities, particularly in the lower-middle-income countries that experience the fastest urbanization rates.
○ Integrated policies to improve the lives of both urban and rural populations are needed.

2.1.2. Growth of Cities

The world urban population growth translates into the growth of cities of all sizes. Figure 5 depicts the growth of the number of cities in four categories: between half and 1 million of inhabitants, between 1 and 5 million inhabitants, between 5 and 10 million inhabitants, and above 10 million inhabitants (UNDESA 2014c). The figure includes numbers from 1990 and 2014 and the projection for 2030. Going forward, the largest growth is expected in the biggest cities of over 10 million and between 5 and 10 million inhabitants (46% each), followed by cities between 0.5 and 1 million (39%) and cities between 1 and 5 million (34%).

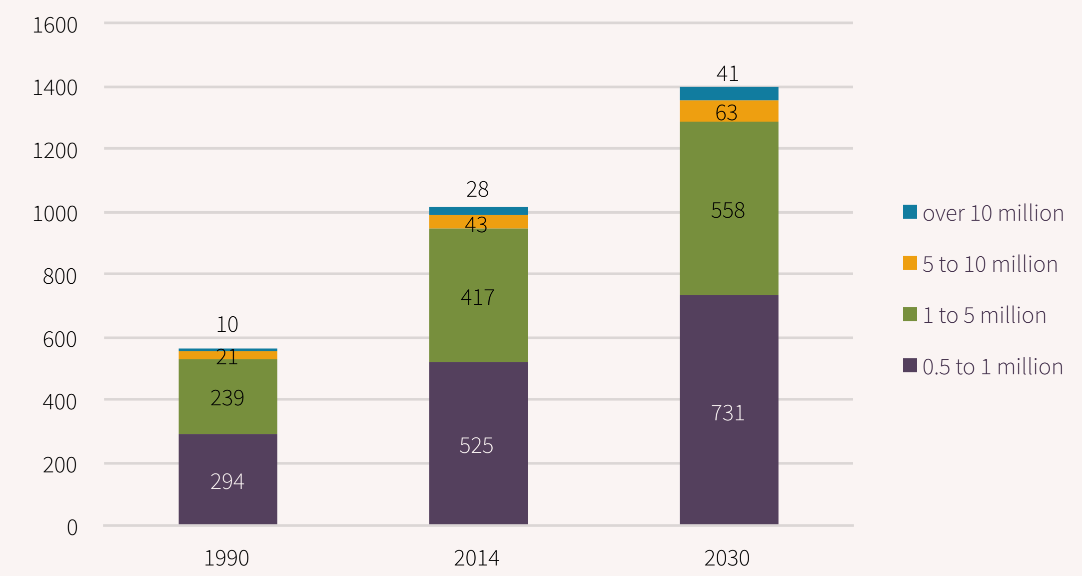

Figure 5: Growth of Cities of Different Sizes

Such growth produced shifts in the definition of megacities. While in 2005 UNDESA considered all cities above 10 million inhabitants as megacities (UNDESA 2006), a few years later UN Habitat raised the bar for megacities to 20 million inhabitants (UN-HABITAT 2008).

According to (UNDESA 2014c), in 1990 there were 10 megacities with a total of 153 million population (7% of the global urban population) while in 2014 there were 28 megacities with 453 million people in total (12% of the global urban population) as depicted in Figure 6. The trend is expected to continue with 41 megacities emerging by 2030.

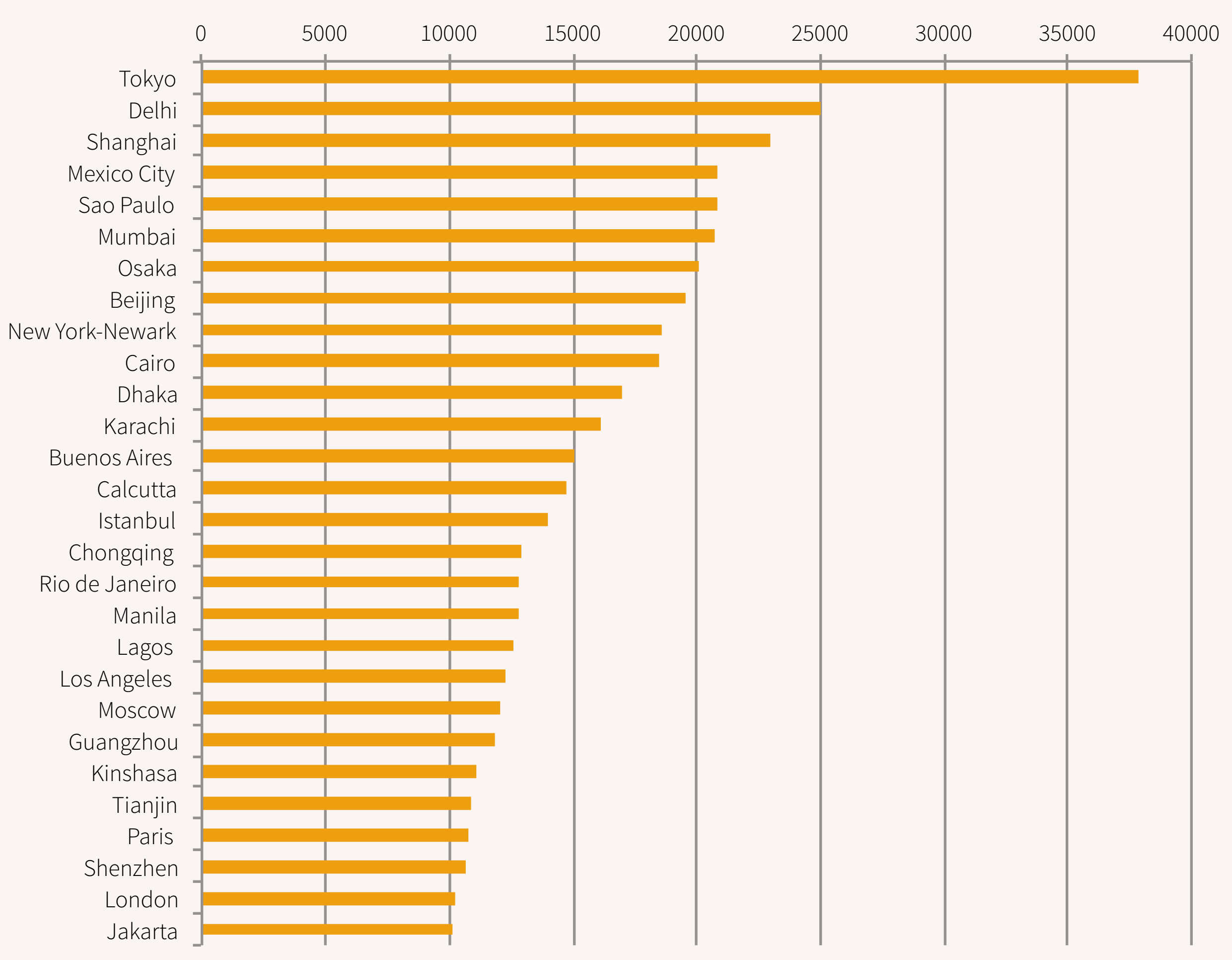

Figure 6: Megacities and their Populations in 2014

Figure 7 depicts the distribution of the 28 mega-cities across continents: 16 (57%) in Asia – Tokyo, Delhi, Shanghai, Mumbai, Osaka, Beijing, Dhaka, Karachi, Buenos Aires, Calcutta, Chongqing, Manila, Moscow, Guangzhou, Tianjin, Shenzhen and Jakarta; 4 (14%) in Latin America – Mexico City, Sao Paulo, Buenos Aires and Rio de Janeiro; 3 (11%) in Africa – Cairo, Lagos and Kinshasa; 3 in Europe – Istanbul, Paris and London; and 2 (7%) in North America – New York and Los Angeles. From the 28 mega-cities, only 6 (21%) are located in developed countries – Tokyo, Osaka, New York, Los Angeles, Paris and London; while 22 (79%) in developing countries.

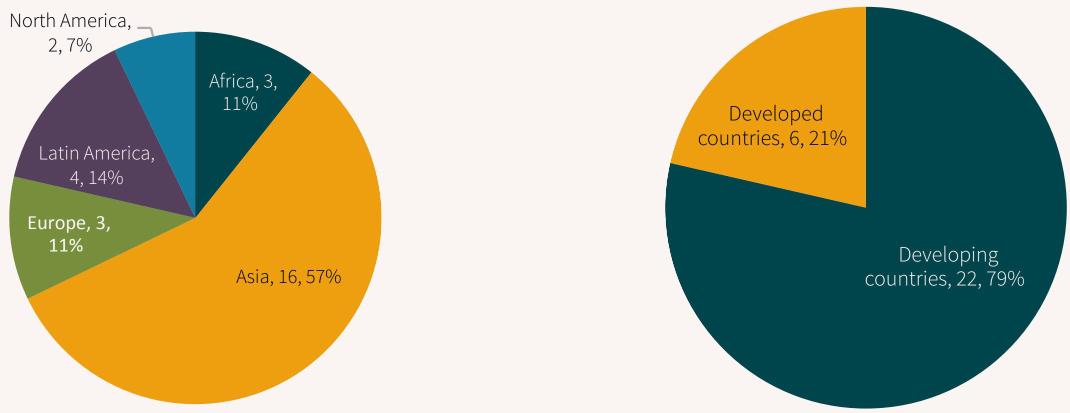

Figure 7: Mega-Cities Per Continent and Per Developed-Developing Countries

2.1.3. Urbanization Challenges

Cities have several distinctive features compared to rural areas: higher concentration of people and fast population growth; manufacturing and services as the primary focus on economic activities; on average three times higher income than in rural areas in the same country; innovation enabled by the presence of universities, research centers and leading companies; regularly conducted cultural activities and significant number of venues where such activities can be performed like, e.g. theaters, cinemas and exhibition halls; and the presence of trading centers. In addition, research and development are mainly concentrated in cities, scientific innovations and engineering breakthroughs mainly occur in cities, and cities are places where most political affairs are settled down (Sacks 2015).

While most economic activities, i.e. about 80% of the world's GDP, occur in cities, such development creates various challenges. For example, cities account for about two-thirds of the global energy demand and produce up to 70% of the global greenhouse gas emissions; with buildings alone accounting for roughly 40% of the world's energy use and producing a fifth of the world's CO2 emissions. In addition, there has been a sharp increase in instances of social instability in major cities across the world due to rising inequalities, unemployment and other factors. Air and water pollution, traffic congestion, and urban violence and crime also constitute major challenges to urban governments and policymakers.

Table 2 summarizes major urbanization challenges (UNDESA 2014b).

Table 2: Urbanization Challenges
○ Humans have built cities for 3 billion people over the course of 3000 years. In the coming 30 years we will build cities for 3 billion more people (WWF Sweden 2012).
○ Every second, the urban population grows by 2 people (UNDESA 2015).
○ In Africa and Asia, the urban population is expected to double between 2000 and 2030 (UNDESA 2015).
○ 828 million people live in temporary housing, lacking basic services such as drinking water and sanitation. Each year, the figures increases by 6 more million people (UNDESA 2015).
○ 62% of the Sub-Saharan Africa urban population and 43% of the urban population of South-Central Asia lives in temporary housing (UNDESA 2015).
○ One in four urban citizens does not have access to improved sanitation (UNDESA 2015).
○ 27% of the urban population in the developing world has no access to piped water at home.
○ Cities account for about 67% of the global energy demand (The World Bank 2014).
○ Buildings represent about 40% of the total energy consumption (IEA 2015).
○ Cities are responsible for up to 70% of harmful greenhouse gases (UN-HABITAT 2011).

2.2. Urbanization and Sustainability

Based on the urbanization trends and challenges explained earlier, a key question for local governments, policymakers, planners and urban citizens is how to make cities sustainable. In short, a city is sustainable if it promotes various dimensions of sustainable development:

- Economic – a city with a healthy, dynamic and responsible economy;
- Social – a city promoting social inclusion and quality of life of its residents;
- Environmental – a city adopting ecological practices to protect its environment; and
- Institutional – a city governed in transparent ways, while engaging its residents.

In addition, sustainable cities are resilient to natural and human-made disasters.

In order to pursue urban sustainability, city planning including provision of electricity, water, sewage, waste management and other utilities, digital and transport infrastructure, public services, education and governance is critical. Core city development issues should not be left to commercial interests only but treated and protected as public goods.

Given the global scale and impact of urbanization, and the difficulty of addressing urban challenges by local government acting alone, the United Nations Open Working Group on Sustainable Development has dedicated one of 17 Sustainable Development Goals (SDGs) to replace Millennium Development Goals (MDGs) when they complete in 2015 to urbanization. Specifically, the content of SDG11 is to "make cities and human settlements inclusive, safe, resilient and sustainable" (UN OWG 2015). Following (UN OWG 2015), seven targets defined to achieve this goals are listed in Table 3 below.

Table 3: Sustainable Development Goal on Urbanization
1. By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums. 2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. 3. By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries. 4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage. 5. By 2030, significantly reduce the number of deaths and the number of people affected and decrease by [x]% the economic losses relative to gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations. 6. By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. 7. By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities. a. Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning. b. By 2020, increase by [x]% the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, develop and implement, in line with the forthcoming Hyogo Framework, holistic disaster risk management at all levels. c. Support the least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.

In order to address the urban sustainability challenges outlined earlier, the urban development model was defined with ecological issues at the core, called Eco-City. The Eco-City model received various definitions including: "An ecologically healthy human settlement modeled on the self-sustaining resilient structure and function of natural ecosystems and living organisms." (EcoCity Builders); or "A city built off the principles of living within the means of the environment." (Wikipedia); or a city that "builds on the synergy and interdependence of ecological and economic sustainability, and their fundamental ability to reinforce each other in the urban context." (The World Bank 2010). Examples of cities that implemented this model include: Guayaquil in Ecuador, Auroville in India, Stockholm in Sweden, Freiburg in Germany and Adelaide in Australia.

2.3. Urbanization and Digitization

To address some of the urbanization and sustainability challenges described in previous sections, cities around the world also started to develop different types of urbanization models strategically relying on the use of digital technologies. Depending on the city context, the vision of urban development and the way in which digital technology supports the city, such models are variably called Digital City, Intelligent City, Smart City or Eco City. Table 4 below presents some definitions of these models, drawing on existing research and policy literature, and illustrates them with examples of cities that adopted the models.

Table 4: Digital, Intelligent, Smart City and Eco City Concepts

CONCEPT	DESCRIPTION	EXAMPLES
DIGITAL CITY	"creatively integrating telecommunications into urban policy and planning practices and strategies, in order to develop more inclusive and sustainable urban futures" (Nunes 2005)	Mexico City, Mexico
INTELLIGENT CITY	"collection of intelligent buildings, shared car and cycle mobility schemes, and various interactive information systems for municipal and privately supplied services and governance, and often linked to the development systems for the 'innovation economy' ". (Weinstock and Gharleghi 2013) Delivering services "using advanced technologies: an integration of a number of innovations including machine-to machine communication enabled by telematics, sensors and RFID technologies; smart grid technologies to enable better energy production and delivery; intelligent software and services; and high-speed communications technologies that serve as a core network for all related city, citizen and business services" (Accenture)	Singapore, Singapore Amsterdam, Netherlands Manchester, UK Helsinki, Finland Neapolis, Cyprus
SMART CITY	Investing "in human and social capital and traditional (transport) and modern (ICT) communication infrastructure to fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu, Del Bo, and Nijkamp 2011) Utilizing "the opportunities presented by Information and Communication Technology (ICT) in promoting … prosperity and influence." (Odendaal 2003) A city where "ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies." (Batty et al. 2012) "a fusion of ideas about how information and communications technologies might improve the functioning of cities, enhancing their efficiency, improving their competitiveness, and providing new ways in which problems of poverty, social deprivation, and poor environment might be addressed" (Batty et al. 2012)	Bangalore, India Cyberjaya, Malaysia Konza, Kenya Montevideo, Uruguay Bogotá, Colombia Medellín, Colombia Curitiba, Brazil Barcelona, Spain Skolkovo, Russia Seattle, USA New York, USA Hong Kong, China

	"user-centered evolution of the other city-concepts which seem to be more technological deterministic in nature." (Schuurman, Baccarne, and De Marez 2012) "urban environment which, supported by pervasive ICT systems, is able to offer advanced and innovative services to citizens in order to improve the overall quality of their life" (Piro et al. 2014) "a generic term to describe IT-based innovative urban ecosystems" (Gabrys 2014) "a 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" (Allwinkle and Cruickshank 2011) (Tranos and Gertner 2012) "how investments in human and social capital and modern ICT infrastructure and e-services fuel sustainable growth and quality of life, enabled by a wise management of natural resources and through participative government" (Schaffers, Ratti, and Komninos 2012) "smart ability to deal with a city's problems and provides citizens with a better living environment through intelligent accumulation and analysis of different kinds of data from the city's routine operation based on advanced information technologies" (Wenge et al. 2014)	
ECO CITY	"An ecologically healthy human settlement modeled on the self-sustaining resilient structure and function of natural ecosystems and living organisms." (EcoCity Builders) "A city built off the principles of living within the means of the environment." (Wikipedia) "An eco-city builds on the synergy and interdependence of ecological and economic sustainability, and their fundamental ability to reinforce each other in the urban context." (The World Bank, 2010)	Guayaquil (Ecuador) Auroville (India) Stockholm (Sweden) Freiburg (Germany) Adelaide (Australia)

A Digital City is clearly based on the integration of digital technology into the city infrastructure, whereas Intelligent Cities and Smart Cities besides technology integration also include innovation, learning, knowledge creation and problem solving, while Eco-Cities emphasize balanced co-existence of nature-made and human-made environments. The major difference between Intelligent Cities and Smart Cities is the special focus of the latter on social and ecological aspects through people and environment dimensions. Table 5 illustrates the major differences between the four models of urbanization.

Table 5: Comparing Digital City, Intelligent City, Smart City and Eco-City Models

DIGITAL CITY	INTELLIGENT CITY	SMART CITY	ECO-CITY
○ Informatics (communication) ○ City portals for online information services	○ Intelligent systems (functionality) ○ Online web-based e-learning systems integrated and interoperable with other city platforms	○ Social and human concerns (quality of life) ○ Ecological systems (sustainability) ○ e-Learning platform and knowledge management ○ Advanced visualization and simulation tools ○ Benchmarking requirements	○ Natural eco-systems ○ Economic development while protecting the environment

Regardless of the urban development model adopted, however, city planning should address the issues of social inclusion, economic development and environmental protection, deploy public policies in pursuit of sustainability, and leverage digital technology in formulating and implementing such plans. An extremely important part of city planning is also learning from other cities, e.g., through the bench-learning, defining measurable goals and indicators, and deploying monitoring mechanisms to assess to what extent the goals are being met.

According to the United Nations (UNDESA 2014a), sustainable cities will be a major engine for pursuing Sustainable Development Goals (UN OWG 2015). As neither national, nor city governments can pursue such goals alone, urban sustainability is a major policy challenge for all levels of government. Any approach to addressing this challenge should fully utilize the potential offered by digitization and pursue a vision of Smart Sustainable City.

3. Methodology

The aim of this section is to explain the methodology that guided the conduct of research underpinning this report. The methodology comprises six main activities that are depicted in Figure 8 and described as follows:

1. *Research Literature Revie*w to identify and document the most significant research literature that shapes the Smart Sustainable City domain;
2. *Policy Literature Review* to identify and document the most significant policy literature including recommendations, initiatives and experiences produced by major international organizations and think tanks worldwide in the domain;
3. *Case Study Development* to document case studies of Smart City initiatives from around the world, including experiences of practitioners that implemented such initiatives, and creating a repository of Smart City initiatives;
4. *Conceptual Framework* to produce a conceptual framework to guide the process of planning, development and evaluation of Smart City initiatives based on the inputs obtained from research literature review, policy literature review and case study development activities;
5. *Synthesis of Findings* to produce a set of policy alternatives for policymakers and developers of Smart Sustainable City initiatives, and a research agenda to decide between such alternatives and support policy implementation; and
6. *Validation of Findings* to organize focus group meetings with policymakers, government practitioners and academic experts to discuss and provide feedback to the findings and validate them in the process.

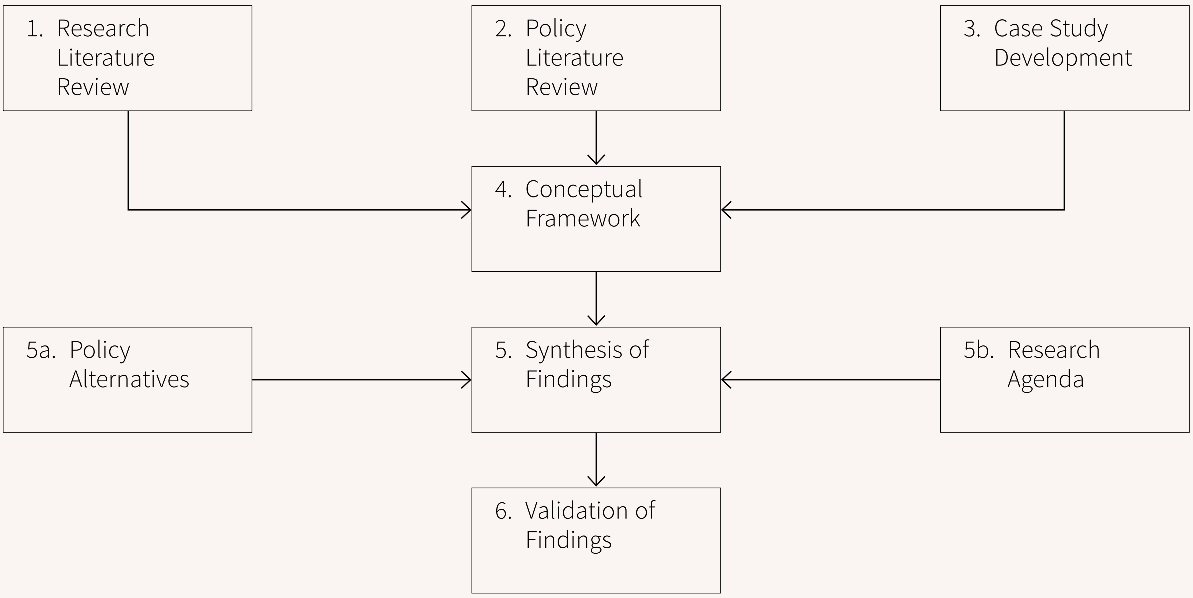

Figure 8: Project Methodology

All decisions concerning the research methodology, in particular those related to data collection, were made by three UNU-EGOV researchers during weekly research review meetings. The detailed methodology adopted for each activity is explained in the following sections.

3.1. Activity 1 – Research Literature Review

The methodology applied to conduct research literature review included four tasks that are is depicted in Figure 9 and described as follows:

1. *Data Collection* to determine data sources, select keywords to search for relevant publications, and defin criteria to identify publications to be analyzed;
2. *Quantitative Analysis* to conduct statistical analysis to determine the research landscape, e.g. investigated themes, the most active institutions and researchers, the years when the research was conducted, and contributing disciplines;
3. *Qualitative Analysis* to document the main findings from the identified research literature, analyzed according to 13 Smart City attributes derived from the project's terms of reference and further study: 1) Innovations, 2) Technologies, 3) Drivers, 4) Challenges, 5) Benefits, 6) Stakeholders, 7) Approaches, 8) Values, 9) Risks, 10) Maturity Models, 11) Tools, 12) Regions and 13) Governance; and
4. *Synthesis* to summarize the major findings obtained from this activity.

More details about data collection and obtained results are provided in Section 4.

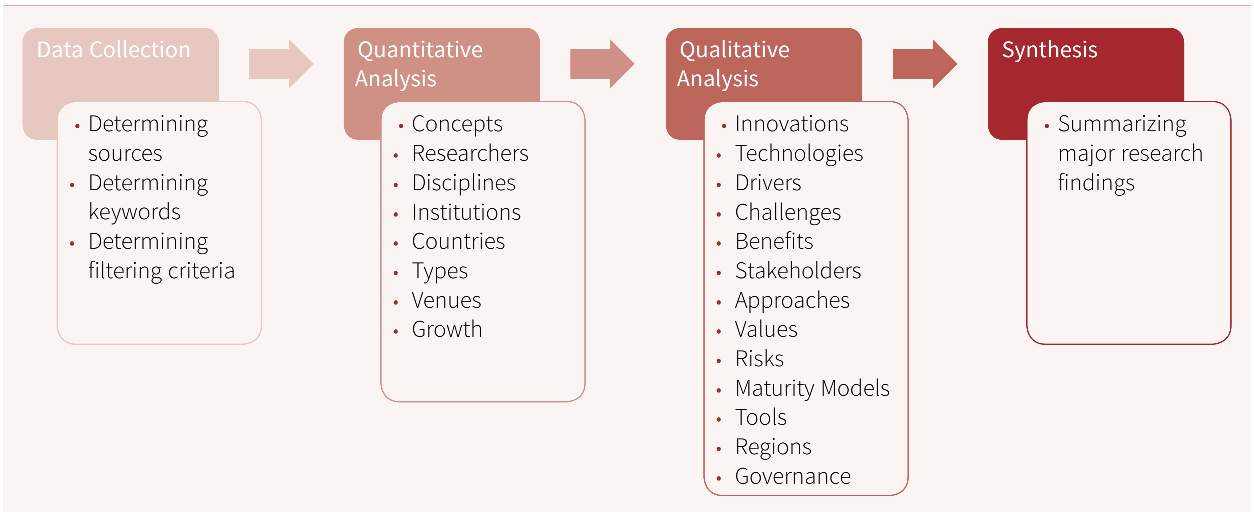

Figure 9: Methodology for Research Literature Review

3.2. Activity 2 – Policy Literature Review

The methodology to conduct the policy literature review comprised four tasks that are depicted in Figure 10 and described as follows:

1. *Data Collection* to determine sources of policy literature including established think tanks, research centers and international organizations that produce relevant research and policy recommendations, and identify concrete policy documents;
2. *Quantitative Analysis* to conduct statistical analysis to determine the key features of the identified policy documents, e.g. policy areas, represented countries, etc.;
3. *Qualitative Analysis* to analyze the policy documents based upon 13 Smart City attributes derived from the project's terms of reference and further study, the same as for the research literature review: 1) Innovations, 2) Technologies, 3) Drivers, 4) Challenges, 5) Benefits, 6) Stakeholders, 7) Approaches, 8) Values, 9) Risks, 10) Maturity Models, 11) Tools, 12) Regions, and 13) Governance; and
4. *Synthesis* to summarize the major findings obtained from this activity.

More details about data collection and obtained results are provided in Section 5.

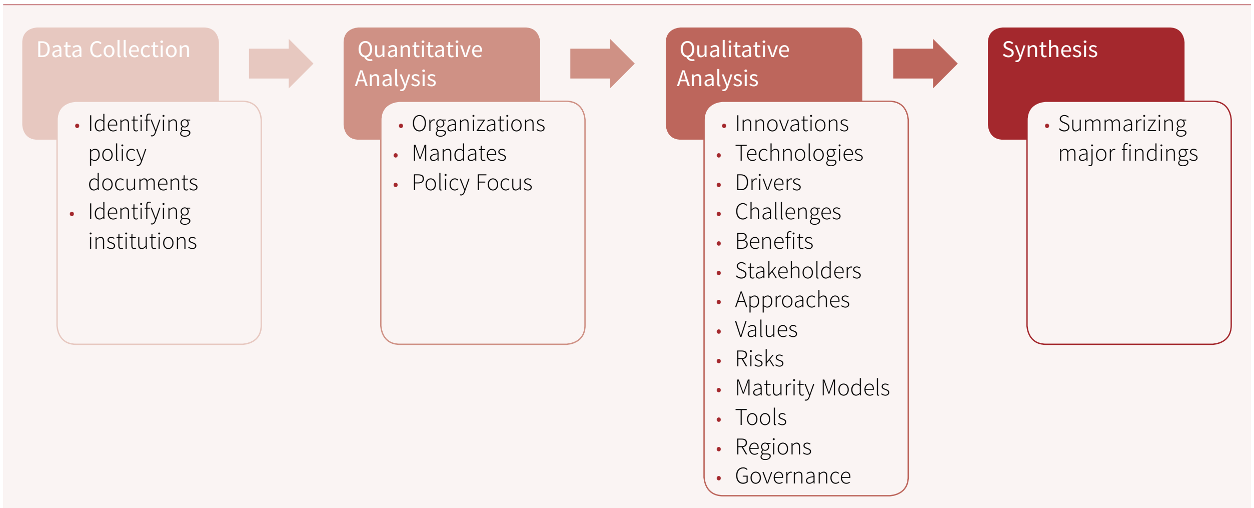

Figure 10: Methodology for Policy Literature Review

3.3. Activity 3 – Case Study Development

The methodology to conduct case study development comprised four tasks that are depicted in Figure 11 and described as follows:

1. *Data Collection* to create a repository of initiatives on Smart Sustainable City, selecting the initiatives to be documented as case studies, and developing these case studies including interviewing experts involved with some of them to obtain access to first-hand experience;
2. *Quantitative Analysis* to conduct statistical analysis to determine the key features of Smart City initiatives, e.g. policy areas, planning and implementation approaches, countries and cities hosting the initiatives, and responsible institutions;
3. *Qualitative Analysis* to obtain in-depth understanding of various case studies and experts' opinions, including the types of initiatives, partners involved, major achievements, and the features analyzed along 13 Smart City attributes derived from the project's terms of reference and further study: 1) Innovations, 2) Technologies, 3) Drivers, 4) Challenges, 5) Benefits, 6) Stakeholders, 7) Approaches, 8) Values, 9) Risks, 10) Maturity Models, 11) Tools, 12) Regions, and 13) Governance; and
4. *Synthesis* to summarize the major findings obtained from this activity.

More details about data collection and obtained results are provided in Section 6.

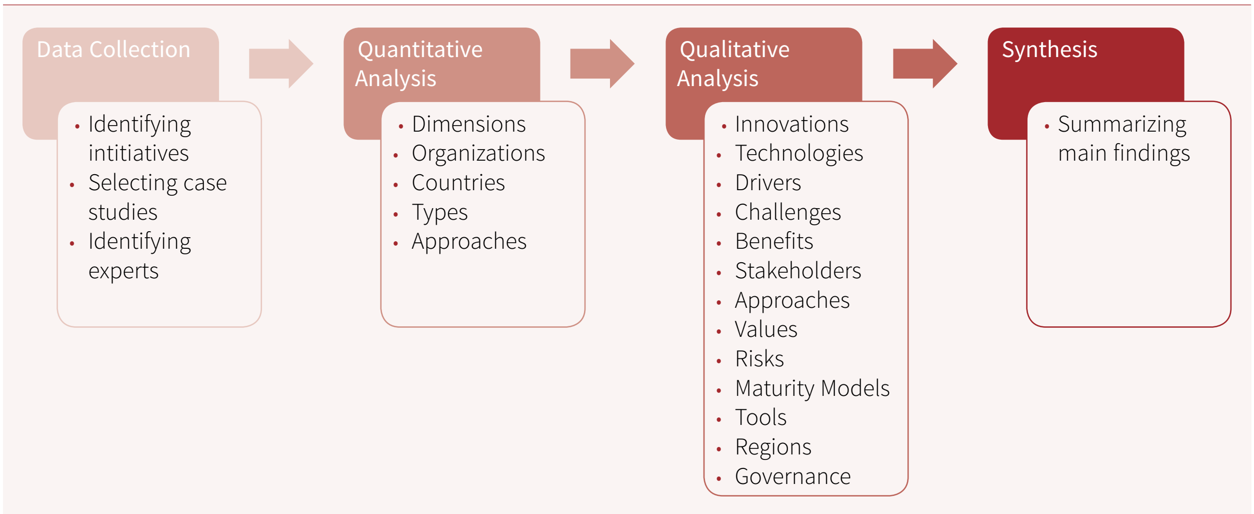

Figure 11: Methodology for Case Study Development

3.4. Activity 4 – Building Conceptual Framework

Based on the inputs obtained from research literature review, policy literature review and case study development, a conceptual framework to underpin planning, implementation and evaluation of Smart Sustainable City initiatives was developed.

The methodology for building the conceptual framework comprised four tasks depicted in Figure 12 and described as follows:

1. *Concept Visioning* to define a vision for Smart Sustainable City and its conceptual framework based on the knowledge obtained from research literature review, policy literature review and case study development;
2. *Framework Modeling* to define the structure of the conceptual framework for Smart Sustainable City based on the vision and the knowledge obtained from previous project activities;

3. *Framework Population* to classify the findings obtained from previous three project activities – research literature review, policy literature review and case study development – to fit the structure of the conceptual framework defined earlier, and populate the framework with such classified findings; and
4. *Framework Review* to conduct research review meetings among researchers involved with the project and visitors to discuss and revise the structure and content of the conceptual framework.

The conceptual framework built through this activity is described in Section 7.

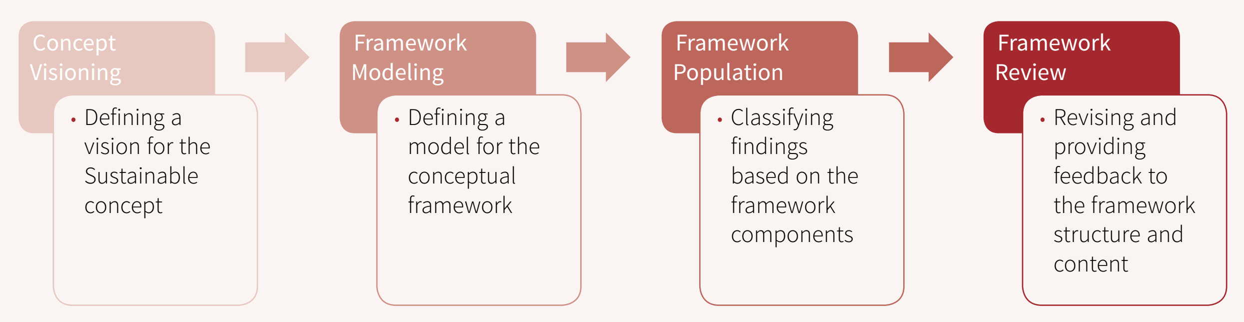

Figure 12: Methodology for Building Conceptual Framework

3.5. Activity 5 – Synthesis of Project Findings

Based upon two major deliverables specified in the project's terms of reference – policy alternatives and research agenda – the methodology for producing such deliverables comprised four tasks that are depicted in Figure 13 and described as follows:

1. *Intervention Areas* to identify major areas of intervention to be considered in Smart Sustainable City initiatives;
2. *Policy Alternatives* to define a set of policy alternatives for each area of intervention identified previously;
3. *Research Agenda* to define possible research problems to help decide between policy alternatives and support the realization of the selected alternative; and
4. *Findings Review* to conduct review meetings among researchers involved in the project to discuss and revise policy alternatives and related research agenda.

The findings of the project, i.e. policy alternatives and research agenda for Smart Sustainable Cities are provided in Section 8.

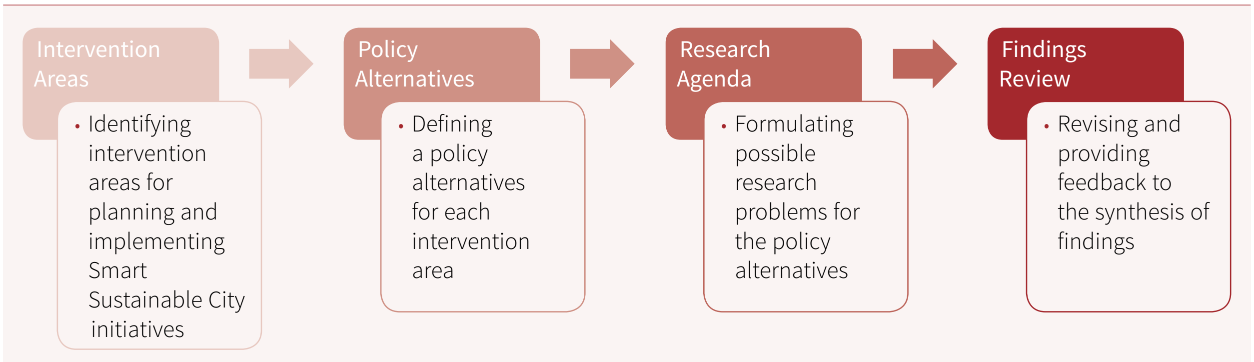

Figure 13: Methodology for Synthesizing Project Findings

3.6. Activity 6 – Validation of Project Findings

As the final project activity, the methodology includes the validation of the project findings. The activity comprised four tasks depicted in Figure 14 and described as follows:

1. *Dissemination Materials* to prepare dissemination materials based on the project findings, including courseware, to be presented to domain experts;
2. *Expert Group Meeting* to organize an expert group meeting to present project findings and receive feedback from experts;
3. *Synthesis of Feedback* to summarize the feedback received from experts; and
4. *Report Updates* to update the conceptual framework, policy alternatives and the research agenda based on the feedback received from experts.

The activity is expected to produce a revised version of this report.

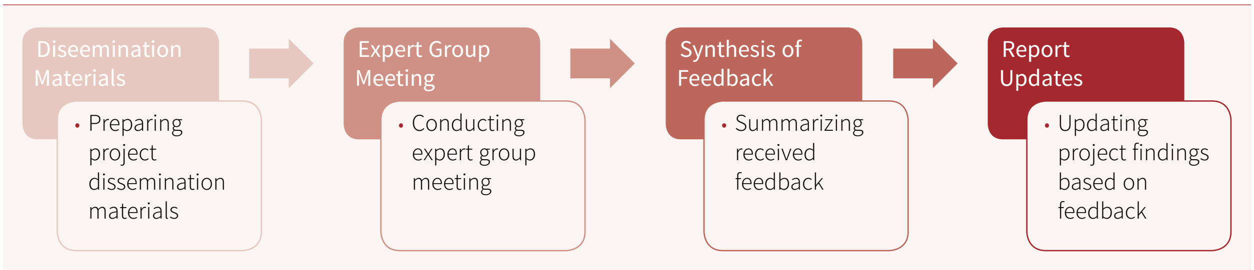

Figure 14: Methodology for Validating Project Findings

4. Research Literature Review

This section presents the outcomes of the research literature review on the topic of Smart City for Sustainable Development.

The section is structured as follows. The process of data collection is explained in Section 4.1, the quantitative analysis of the collected research literature is outlined in Section 4.2, and the qualitative analysis of the research literature along 13 dimensions of the Smart City derived from the project's terms of reference and further study is outlined in Section 4.3.

4.1. Data Collection

The data collection process involved three main tasks: 1) determining the sources for collecting research literature; 2) defining keywords for identifying relevant publications from these sources; and 3) defining other criteria to narrow down the keyword-based search to obtain a reasonable number of publications for detailed analysis.

Two databases of research literature were consulted – Scopus (Elsevier 2015) and Web of Science (Thomson Reuters 2015) – both of them leading sources of scholarly research data. Scopus covers more than 21,000 journal titles from more than 5,000 publishers[1] and focuses on Life Sciences, Social Sciences, Physical Sciences and Health Sciences. Web of Science covers more than 18,000 journals worldwide including open access journals[2], and focuses on Social Sciences and Art and Humanities, and conference proceedings in all fields of science. Both databases provide tools for tracking, analyzing and visualizing important statistics of the publications, and enable exporting bibliographic information in different formats. A comparison between Scopus and the Web of Science is presented in Table 6.

Table 6: Comparing Scopus and Web of Science

CRITERIA	SCOPUS	WEB OF SCIENCE
Producer	Elsevier	Thomson Reuters
Focus	Social, Physical, Health, Life Sciences	Social Sciences, Art and Humanities
Journals	21,000+	18,000+

1 http://www.elsevier.com/online-tools/scopus/content-overview

2 http://thomsonreuters.com/content/dam/openweb/documents/pdf/scholarly-scientific-research/fact-sheet/wos-next-gen-brochure.pdf

Records	54 Million	90 Million +
Unique titles1	8432	19809
Citation analysis	Yes	Yes
Analytical tools	Yes	Yes
Export feature	Yes	Yes

Following a discussion about the relevance of both databases for the current research, Scopus was selected as the main literature source due to its coverage of journal publications and hard sciences, e.g. computer science, relevant to Smart City initiatives.

After selecting the source of literature, the next step involved defining keywords to search this source for relevant publications. The keywords were mainly derived from the project's terms of reference and included "smart city", "digital city", "intelligent city", "innovation" and "development" and related terms in both singular and plural forms as the follows:

> *("smart city" OR "smart cities" OR "digital city" OR "digital cities" OR "intelligent city" OR "intelligent cities") AND ("development" OR "developments" OR "develop" OR "developing" OR "innovation" OR "innovations" OR "innovative" OR "innovate")*

This expression was applied to search on Scopus on 2 February 2015 against article titles, abstracts and keywords, and produced 876 publications. The bibliographic information of these publications was exported to an Excel file shown in Figure 15.

Nº	YEAR	AUTHORS	TITLE	SOURCE TITLE	VOLUME
1	2015	Das D.	Hyderabad: Visioning, restructuring and making of a high-tech city	Cities	43
2	2015	Krishnamurthy R., Desouza K.C.	Chennai, India	Cities	42
3	2015	Ryu M., Kim J., Yun J.	Integrated semantics service platform for the internet of things: A case study of a smart office	Sensors (Switzerland)	15
4	2015	Poveda-Villalon M., Garcia-Castro R., Gomez-Perez A.	Building an ontology catalogue for Smart Cities	eWork and eBusiness in Architecture, Engineering and Construction - Proceedings of the 10th European Conference on Product and Process Modelling, ECPPM 2014	
5	2015	Redmond A., Fies B., Zarli A.	Developing an integrated cloud platform for enabling 'holistic energy management' in urban areas	eWork and eBusiness in Architecture, Engineering and Construction - Proceedings of the 10th European Conference on Product and Process Modelling, ECPPM 2014	
6	2014	Lee J.H., Hancock M.G., Hu M.-C.	Towards an effective framework for building Smart Cities: Lessons from Seoul and San Francisco	Technological Forecasting and Social Change	89
7	2014	Yuan Z., Zheng X., Lv L., Xue C.	From design to digital model: A quantitative analysis approach to Garden Cities theory	Ecological Modelling	289
8	2014	Liu P., Peng Z.	China's smart city pilots: A progress report	Computer	47

9	2014	Paganelli F., Turchi S., Giuli D.	A Web of Things Framework for RESTful Applications and Its Experimentation in a Smart City	IEEE Systems Journal	
10	2014	Carvalho L., Santos I.P., Van Winden W.	Knowledge spaces and places: From the perspective of a "born-global" start-up in the field of urban technology	Expert Systems with Applications	41
11	2014	Horng G.-J.	The Adaptive Recommendation Mechanism for Distributed Parking Service in Smart City	Wireless Personal Communications	
12	2014	Cohen B., Amoros J.E.	Municipal demand-side policy tools and the strategic management of technology life cycles	Technovation	
13	2014	Angelidou M.	Smart city policies: A spatial approach	Cities	
14	2014	Kan X., Sun J.	Application of LiDAR and oblique photogrammetric technology in digital real city model	Journal of Geomatics	39
15	2014	Neirotti P., De Marco A., Cagliano A.C., Mangano G., Scorrano F.	Current trends in smart city initiatives: Some stylised facts	Cities	38
861	2003	Groenewegen P., Taminiau Y.	The Strength of Social Embeddedness: Societal and Cultural Activism, as Conditions for Early Internet Entrepreneurs in Amsterdam	IEEE International Engineering Management Conference	
862	2003	Firmino R.J.	"Not just portals:" Virtual cities as complex sociotechnical phenomena	Journal of Urban Technology	10
863	2003	Yan D., Zhao Z.	Road Detection from Quickbird Fused Image Using IHS Transform and Morphology	International Geoscience and Remote Sensing Symposium (IGARSS)	6
864	2003	Odendaal N.	Information and communication technology and local governance: Understanding the difference between cities in developed and emerging economies	Computers, Environment and Urban Systems	27
865	2003	Santana S., Rocha N.	Telework: Employment opportunities for a disabled citizen	ICEIS 2003 - Proceedings of the 5th International Conference on Enterprise Information Systems	3
866	2002	Bunnell T.	Multimedia utopia? A geographical critique of high-tech development in Malaysia's multimedia super corridor	Antipode	34
867	2001	Oyama S., Hiramatsu K., Ishida T.	Cooperative information agents for digital cities	International Journal of Cooperative Information Systems	10
868	2001	Graf P.	Information and communication technologies in the city [Informations- und Kommunikationstechnologien in der Stadt]	Berichte zur Deutschen Landeskunde	75
869	2000	Firmeza J.P., Fontes F.	Aveiro digital city: A case study for a multi-services community network	Journal of the Institution of British Telecommunications Engineers	1

870	2000	Steyaert J.	Local governments online and the role of the resident: Government shop versus electronic community	Social Science Computer Review	18
871	1999	Thiemann W., Hagele F.	The new diesel engine for the smart and its contribution to the 3-liter-car [Der neue Dieselmotor fÃ¼r den smart und sein Beitrag zum 3-Liter-Autor]	VDI Berichte	
872	1999	Yatabe Tomoyuki, Kawasaki Hiroshi, Sakauchi Masao	Interactive video description on the network - interactive video representation of real world based on digital city map	International Conference on Multimedia Computing and Systems -Proceedings	2
873	1995	Carter N., Brine J.	MFP Australia: a vision of sustainable development for a post- industrial society	Planning Practice & Research	10
874	1993	Toh Mun Heng, Low L.	The intelligent city: Singapore achieving the next lap	Technology Analysis & Strategic Management	5
875	1993	Azegami Moriaki, Fujiyoshi Hideaki	Systematic approach to intelligent building design	IEEE Communications Magazine	31
876	1987	Ishii T.	The Japan Corridor, cradle of tomorrow's civilization (technological development)	Japan Echo	14

Figure 15: The Result of Research Literature Search on Scopus

To conduct detailed data analysis, the research team decided to narrow down the number of publications by applying a three-step filtering process. The first step involved selecting: 1) the most relevant publications – all journal articles, all book chapters and only those conference papers that were cited more than 10 times; and 2) the most recent publications – all conference papers published since 2014. The selection produced 443 publications including a number of publications for each criterion applied, as shown in Table 7.

Table 7: Data Collection for Research Literature Review – First Filtering

CRITERIA	RESULTS
Journal articles	310
Book chapters	13
Conference papers cited more than 10 times	6
Conference papers since 2014	127
TOTAL NUMBER OF SELECTED PUBLICATIONS	443

The second step involved determining manually the relevance of each the 443 publications selected on the previous step to the process. The determination was based on the publications' titles and abstracts. In total, 352 papers were classified as relevant and 91 papers as non-relevant, as shown in Table 8.

Table 8: Data Collection for Research Literature Review – Second Filtering

CRITERIA	RESULTS
Relevant papers to this research	352
Non-relevant papers to this research	91
TOTAL NUMBER OF SELECTED PUBLICATIONS	352

The third step involved classifying each of the 352 papers selected in the previous step based on their titles and abstracts to one or more of the Smart City sectors: 1) Economy, 2) Governance, 3) Mobility, 4) Environment, 5) Living and 6) People. A paper was considered "sectoral" if it was classified to belong to one sector and otherwise "cross-sectoral". In total, 226 papers were classified as sectoral and 126 as cross-sectoral, and the latter were selected from this step. However, among the 126 papers, 14 were not in English, 3 were books and 6 were unavailable, therefore 103 papers were selected from this step for detailed analysis. The number of papers resulting from each criteria applied is shown in Table 9.

The tools used to support data collection included Scopus, Excel, Mendeley[3] and XMind[4].

Table 9: Data Collection for Research Literature Review – Third Filtering

CRITERIA	RESULTS
Cross-sectoral publications	126
Sectoral publications	226
Publications not in English	14
Book publications	3
Non-available publications	6
TOTAL NUMBER OF SELECTED PUBLICATIONS	103

4.2. Quantitative Analysis

The 876 papers identified at the outset of data collection were analyzed quantitatively to determine the Smart City for Sustainable Development research landscape. The analysis focused on eight aspects, each covered by subsequent sections:

1. Concepts – Section 4.2.1
2. Researchers – Section 4.2.2
3. Researcher disciplines – Section 4.2.3
4. Researcher institutions – Section 4.2.4
5. Researcher countries – Section 4.2.5
6. Publication types – Section 4.2.6
7. Publication venues – Section 4.2.7
8. Publication growth – Section 4.2.8

4.2.1. Aspect 1 – Concepts

The occurrence of key concepts of interest, based on the project's terms of reference, among selected papers include: smart city – 854; development – 679; technology – 616; innovation – 319; digital city – 318; challenges – 297; approaches – 240; tools – 174; policy – 111; values – 109; regions – 108; benefits – 88; intelligent city – 84; stakeholders – 80; governance – 58; risks – 52; drivers – 40; and maturity – 13. The results are depicted in Figure 16.

The results show that "smart city", "development" and "technology", in this order, are by far the most popular concepts for Smart City research. The concepts in the second most popular group – "innovation", "digital city",

[3] https://www.mendeley.com/

[4] https://www.xmind.net/

"challenges", "approaches" and "tools" – also appear in a significant number of publications, an indicator of their importance to Smart City research. The remaining concepts – "policy", "values", "regions", "benefits", "intelligent city", "stakeholders", "governance", "risks", "drivers" and "maturity" – appear in a smaller number of papers.

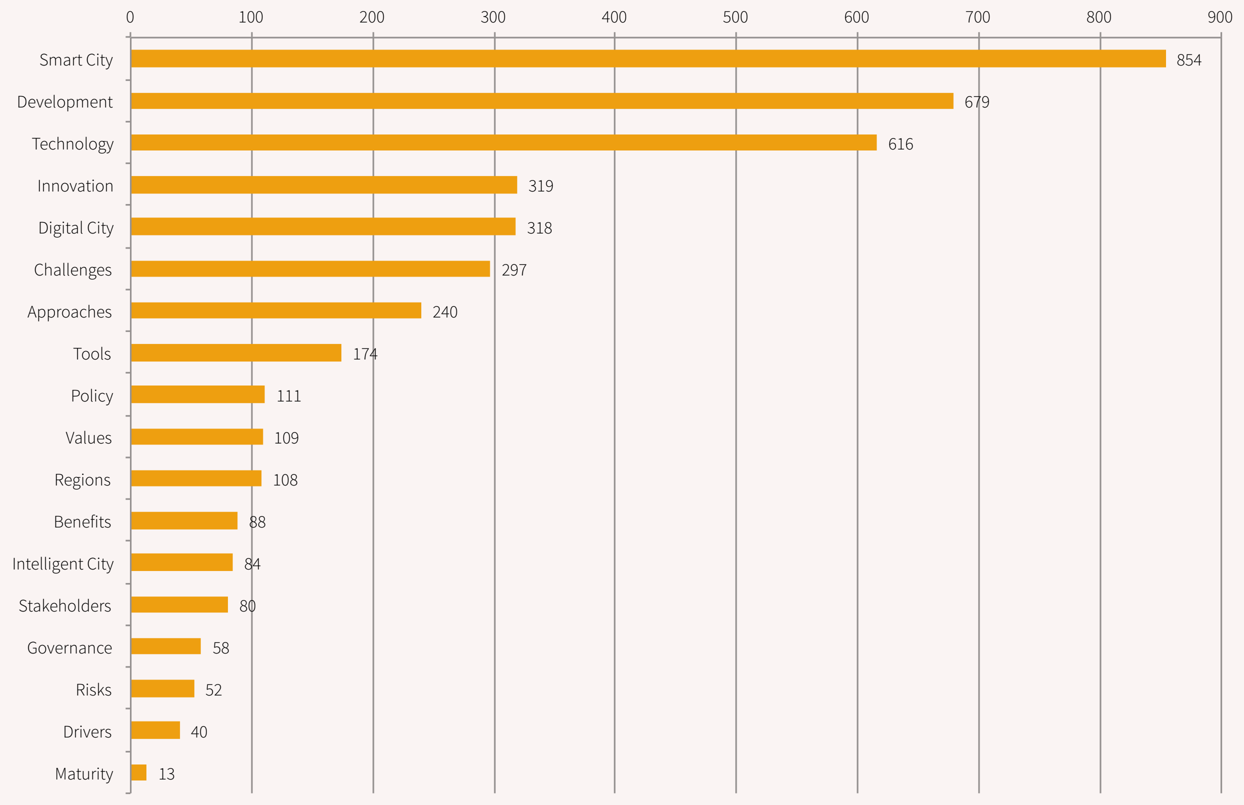

Figure 16: State of Research Quantitative Analysis, Aspect 1 – Concepts

4.2.2. Aspect 2 – Researchers

Based on the paper authorship, the researchers with five or more Smart City publications are depicted in Figure 17 and listed below. The researchers with the largest number of papers are Paolo Bellavista from the University of Bologna, Spain, and Nicos Komninos from the Aristotle University of Thessalonik, Greece, eight papers each; followed by Mark Deakin from Edinburgh Napier University, UK, and Luis Muñoz from the University of Cantabria, Spain, seven papers each; followed by Taewoo Nam from Myongji University, Republic of Korea and Theresa Pardo from University at Albany, USA, and Athena Vakali from the University of Thessaloniki, Greece, six papers each. The remaining authors all have five publications: Athena Vakali from Aristotle University, Greece; Antonio Corradi and Luca Fuschini from the University of Bologna, Italy; Jose Antonio Galache and Luis Sanchez from the University of Cantabria, Spain; Raffaelle de Amicis from the University of Trento, Italy; Gwo-Jiun Horng from Southern Taiwan University of Science and Technology, Taiwan; Thomas Magedanz from Berlin Technical University, Germany; Peter Nijkamp from Amsterdam VU University, Netherlands; Chun Yuan Tao from Jiujiang University, China; and Yin Xiang Wang from Gongqing Management and Investment, Ltd., China. All except two researchers are from the developed world.

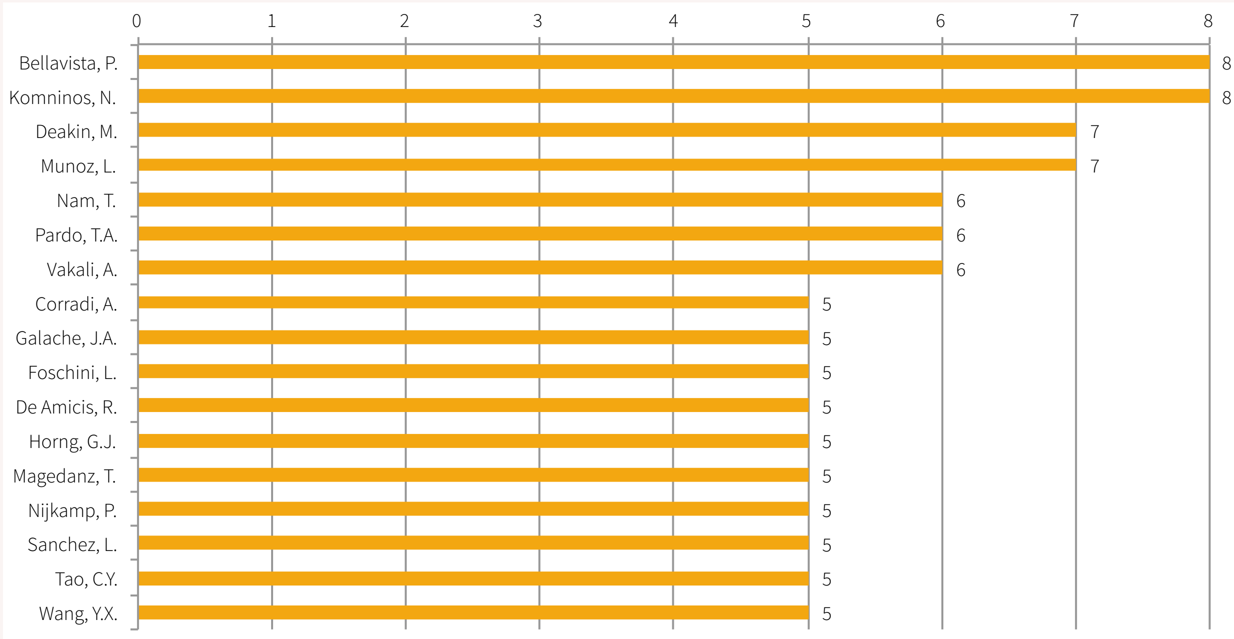

Figure 17: State of Research Quantitative Analysis, Aspect 2 – Researchers

4.2.3. Aspect 3 – Researcher Disciplines

Based on the researcher affiliations, the list of contributing disciplines and the percentages of researchers belonging to them are depicted in Figure 18 and listed in Table 10. Clearly, the area is dominated by Computer Science (36%) and Engineering (22%) highlighting a strong technical focus for Smart City research, followed by Social Sciences (10%), Mathematics (7%), Business, Management and Accounting (6%), Environmental Sciences (4%) and Earth and Planetary Sciences (3%). The remaining disciplines presented at below 3% are: Energy; Decision Sciences; Physics and Astronomy; Materials Science; Chemical Engineering; Arts and Humanities; Economics, Econometrics and Finance; Psychology; Biochemistry, Genetics and Molecular Biology; Chemistry; Medicine; Health Professions; and Pharmacology, Toxicology and Pharmaceutics. In addition, 5 researchers did no declare any discipline. The number of disciplines present in the Smart City research highlights the complexity of the domain and the variety of problems addressed by such research.

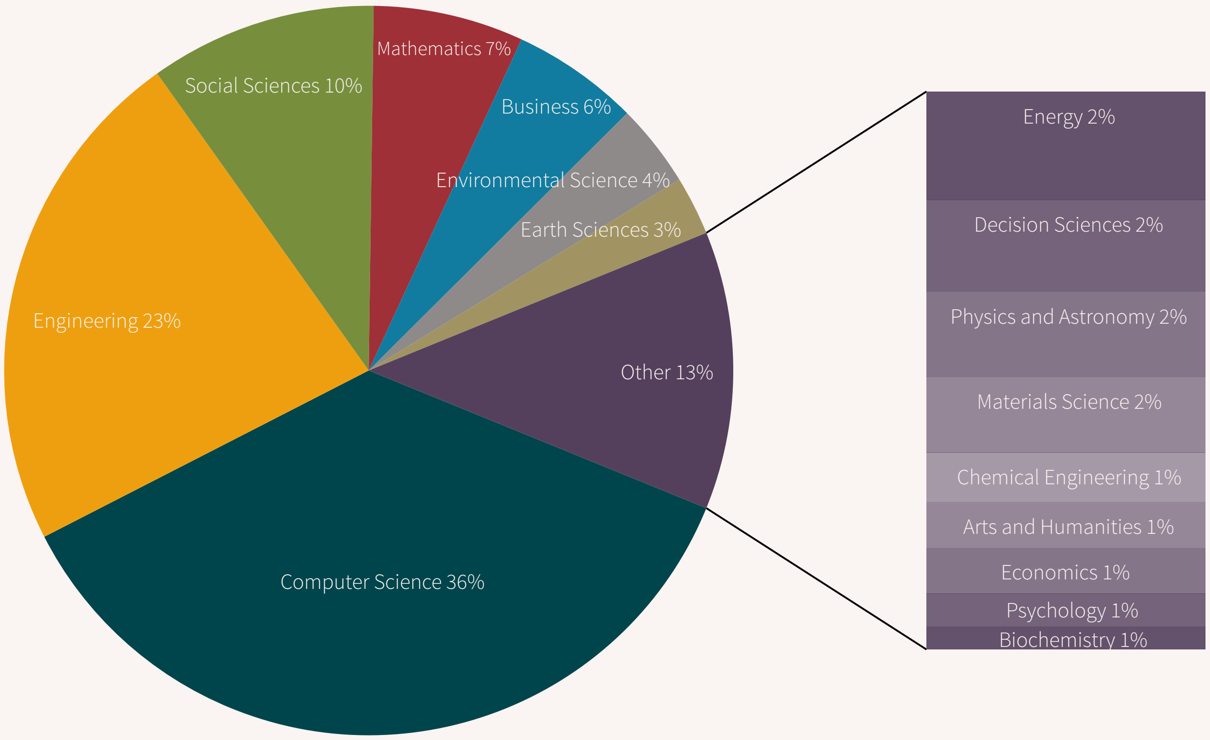

Figure 18: State of Research Quantitative Analysis, Aspect 3 – Disciplines

Table 10: State of Research Quantitative Analysis, Aspect 3 – Disciplines

NO	DISCIPLINE	RESEARCHERS	PERCENTAGE
1	Computer Science	501	36%
2	Engineering	313	23%
3	Social Sciences	139	10%
4	Mathematics	92	7%
5	Business, Management and Accounting	78	6%
6	Environmental Science	51	4%
7	Earth and Planetary Sciences	36	3%
8	Energy	33	2%
9	Decision Sciences	28	2%
10	Physics and Astronomy	26	2%
11	Materials Science	23	2%
12	Chemical Engineering	15	1%
13	Arts and Humanities	14	1%
14	Economics, Econometrics and Finance	14	1%
15	Psychology	10	1%
16	Biochemistry, Genetics and Molecular Biology	7	1%
17	Chemistry	3	0%
18	Medicine	3	0%
19	Health Professions	2	0%
20	Pharmacology, Toxicology and Pharmaceutics	1	0%

4.2.4. Aspect 4 – Researcher Institutions

Based on researcher affiliations, the most productive Smart City research institutions include: 1) Aristotle University of Thessaloniki[5], Greece with 18 publications; 2) Wuhan University[6], China with 15 publications; 3) University of Bologna[7], Italy with 14 publications; 4) Tsinghua University[8], China with 12 publications; 5) IBM with 12 publications; 6) Polytechnic of Milan[9], Italy with 10 publications; 7) Fujitsu[10] with 9 publications; 8) University of Cantabria[11], Spain with 8 publications; and 9) Harbin Institute of Technology[12], China with 8 publications. Clearly, European countries and China dominate the area. The institutions are depicted in Figure 19 and listed in Table 11.

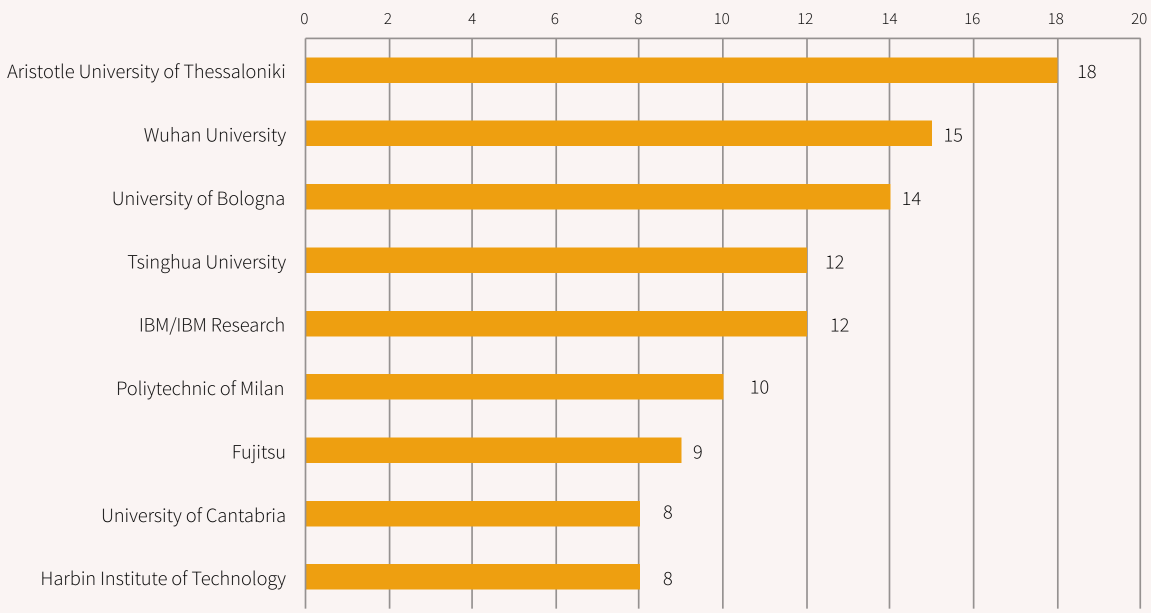

Figure 19: State of Research Quantitative Analysis, Aspect 4 – Institutions

Table 11: State of Research Quantitative Analysis, Aspect 4 – Institutions

NO	INSTITUTION	COUNTRY	PAPERS
1	Aristotle University of Thessaloniki	Greece	18
2	Wuhan University	China	15
3	University of Bologna	Italy	14
4	Tsinghua University	China	12
5	IBM and IBM Research	International, USA (HQ)	12
6	Polytechnic of Milan	Italy	10
7	Fujitsu	International, Japan (HQ)	9

5 https://www.auth.gr/en
6 http://en.whu.edu.cn/
7 http://www.unibo.it/it
8 http://www.tsinghua.edu.cn/publish/newthu/index.html
9 http://www.polimi.it/en/english-version/
10 http://www.fujitsu.com/global/
11 http://web.unican.es/en/Pages/default.aspx
12 http://en.hit.edu.cn/

8	Universidad de Cantabria	Spain	8
9	Harbin Institute of Technology	China	8
10	Zhejiang University	China	7
11	Universitat Politecnica de Catalunya	Spain	7
12	University at Albany, State University of New York	USA	7
13	Beihang University	China	7
14	Peking University	China	7
15	Yonsei University	Republic of Korea	7
16	Universita di Pisa	Italy	7
17	National University of Ireland Galway	Ireland	6
18	Vrije Universiteit Amsterdam	Netherlands	6
19	Technische Universitat Berlin	Germany	6
20	Napier University	UK	6
21	Universidade do Minho	Portugal	6
22	Universita degli Studi di Roma La Sapienza	Italy	6
23	Fraunhofer Institute for Open Communication Systems	Germany	6
24	Jiujiang University	China	6
25	Gongqing Management and Investment Ltd	China	5
26	Universidad de Murcia	Spain	5
27	University Politehnica of Bucharest	Romania	5
28	Universidad de Malaga	Spain	5
29	Newcastle University, United Kingdom	UK	5
30	Kyoto University	Japan	5
31	Politecnico di Torino	Italy	5
32	University of Oulu	Finland	5
33	University College London (UCL)	UK	5
34	Shanghai University	China	5
35	Shanghai Jiaotong University	China	5
36	Universiti Putra Malaysia	Malaysia	5
37	National University of Ireland, Maynooth	Ireland	5
38	Universidade Estadual de Campinas	Brazil	5
39	Northeastern University China	China	5
40	Universite Laval	Canada	5
41	Tongji University	China	5
42	CREATE-NET	Italy	5
43	Aalto University	Finland	5

4.2.5. Aspect 5 – Researcher Countries

Based on researcher and institutional affiliations, the leading countries that host Smart City research include: China, Italy, Spain, UK, USA, Japan, Greece, Germany, France, Canada, Portugal, South Korea, Ireland, Netherlands, Finland, Taiwan, Belgium, Australia, Brazil, Sweden, Malaysia, Austria, and Singapore. The results, including the numbers of publications produced per country are depicted in Figure 20.

The results show that China more than doubles the number of publications with respect to the second country in the list. Regionally, the leading countries are USA (64) and Canada (22) in the Americas; China (202), Japan (55) and South Korea (19) in Asia; Italy (95), Spain (77) and the UK (75) in Europe; Australia (14) in Oceania; and South Africa (5) publishes the most in Africa. Concerning developing countries outside China, only Brazil (12) and Malaysia (11) reached the 10 paper threshold.

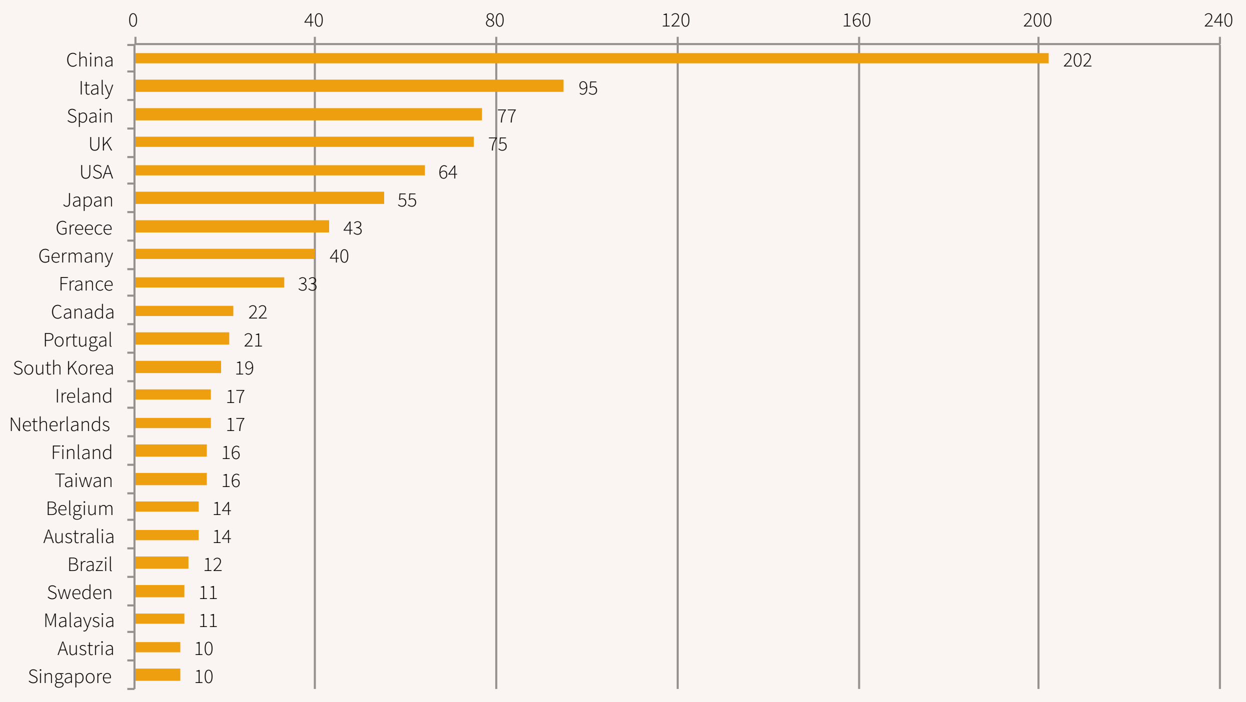

Figure 20: State of Research Quantitative Analysis, Aspect 5 – Countries

4.2.6. Aspect 6 – Publication Types

As depicted by Figure 21, by far the majority of Smart City research papers were published as Conference Papers – 489 (56%) or Journal Articles – 314 (36%). The rest includes 32 (4%) Conference Reviews, 22 (2%) Reviews, 13 (1%) Book Chapters and 6 (1%) Books.

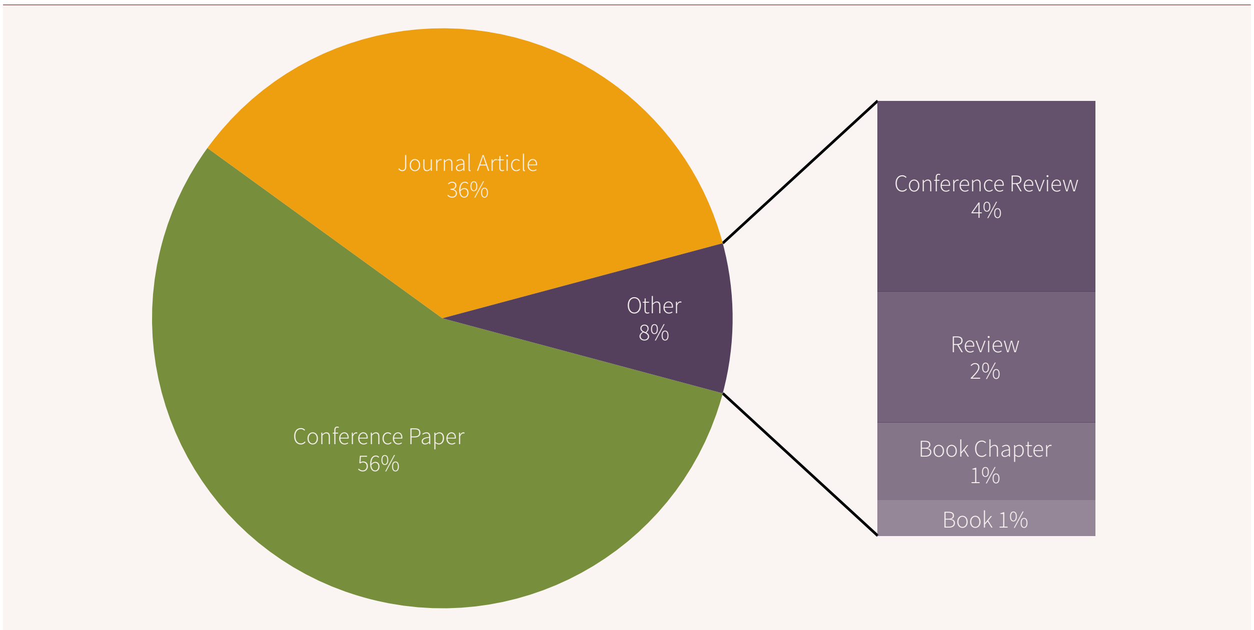

Figure 21: State of Research Quantitative Analysis, Aspect 6 – Types Papers

4.2.7. Aspect 7 – Publication Venues

Considering the types of Smart City research papers, preferred venues to publish such papers include, in the order of popularity: "Lecture Notes in Computer Science"[13] by Springer with, "Applied Mechanics and Materials"[14] by Trans Tech Publications Inc., "Advanced Materials Research"[15] by Trans Tech Publications Inc., "Proceedings of the International Society for Optics and Photonics (SPIE)"[16] by SPIE, "Journal of Urban Technology"[17] by Taylor & Francis Online, "Hitachi Review"[18] by Hitachi Group, and "Communications in Computer and Information Science"[19] by Springer. Figure 22 depicts the venues with over 10 publication, and Table 12 lists with all venues with 5 and more publications.

13 http://www.springer.com/computer/lncs?SGWID=0-164-0-0-0
14 http://www.ttp.net/1660-9336.html
15 http://www.ttp.net/1022-6680.html
16 http://spiedigitallibrary.org/
17 http://www.tandfonline.com/toc/cjut20/current#.VR_t-PnF98E
18 http://www.hitachi.com/rev/
19 http://www.springer.com/series/7899

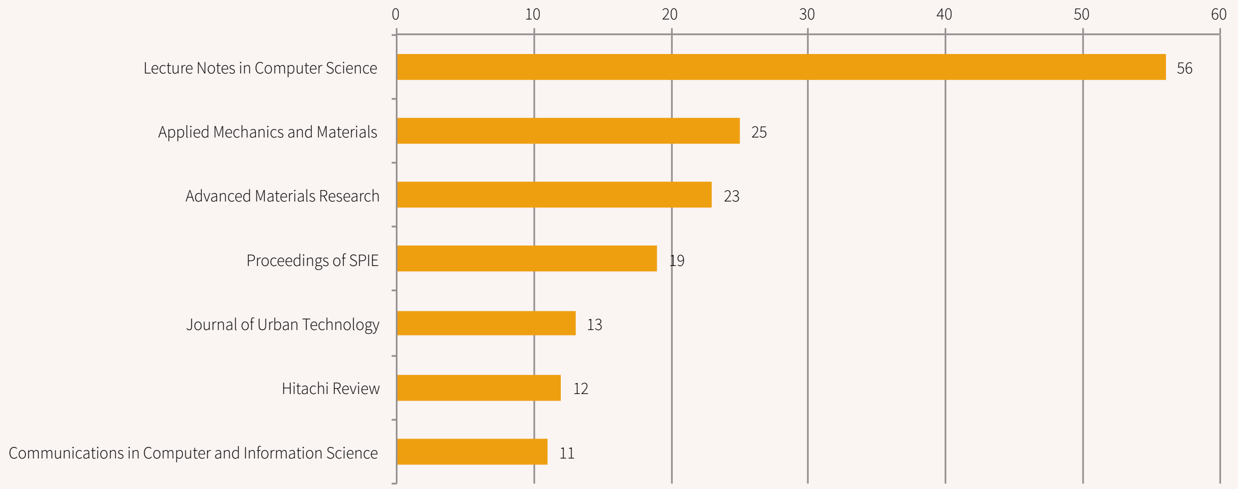

Figure 22: State of Research Quantitative Analysis, Aspect 7 – Publication Venues

Table 12: State of Research Quantitative Analysis, Aspect 7 – Publication Venues

NO	VENUE	TYPE	PAPERS
1	Lecture Notes in Computer Science	Journal	56
2	Applied Mechanics and Materials	Journal	25
3	Advanced Materials Research	Journal	23
4	Proceed. of SPIE the International Society for Optical Engineering	Conference	19
5	Journal of Urban Technology	Journal	13
6	Hitachi Review	Journal	12
7	Communications in Computer and Information Science	Journal	11
8	Revista De Obras Publicas	Journal	9
9	Technological Forecasting and Social Change	Journal	8
10	Wit Transactions on Ecology and the Environment	Journal	8
11	Fujitsu Scientific and Technical Journal	Journal	8
12	IEEE Communications Magazine	Journal	7
13	Telematics and Informatics	Journal	7
14	Journal of the Knowledge Economy	Journal	6
15	Cities	Journal	6
16	Wireless Personal Communications	Journal	6
17	Journal of Theoretical and Applied Electronic Commerce Research	Journal	5
18	NEC Technical Journal	Journal	5
19	International Geoscience and Remote Sensing Symposium	Conference	5
20	Innovations	Journal	5
21	Intelligent Buildings International	Journal	5

4.2.8. Aspect 8 – Publication Growth

The growth of Smart City research started in 1987 when the first paper was published on the topic, but the research remained scarce until 2002, with only 11 papers published during 16 years. Between 2003 and 2009, the research started to increase to 26 publications in 2005, 16 and 18 publications in 2006 and 2007 respectively, and to 22 and 24 publications in 2008 and 2009 respectively. Since 2010, the number of publications started to sharply increase and reached 49 in 2010 and 257 in 2014. In the last five years, the number of Smart City publications increased more than tenfold. The small number of publications in 2015 is due to the search being conducted in early February 2015. The annual growth of Smart City research between 1987 and 2015 is depicted in Figure 23.

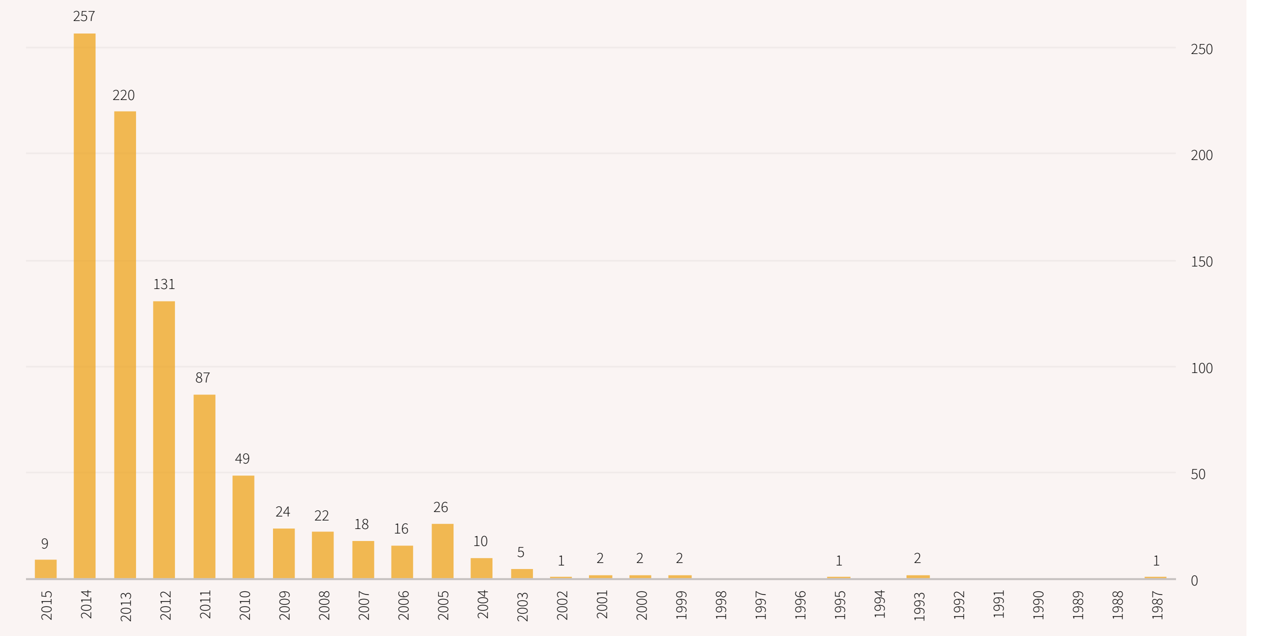

Figure 23: State of Research Quantitative Analysis, Aspect 8 – Publication Growth

4.3. Qualitative Analysis

This section presents the qualitative analysis of the content of 103 papers selected during data collection for detailed analysis. The analysis aimed at establishing if and how the selected papers address each of the 13 Smart City Attributes derived from the project's terms of reference and further study. The result are outlined in subsequent sections:

1. Values – Section 4.3.1
2. Drivers – Section 4.3.2
3. Challenges – Section 4.3.3
4. Risks – Section 4.3.4
5. Regions – Section 4.3.5
6. Technologies – Section 4.3.6
7. Tools – Section 4.3.7
8. Approaches – Section 4.3.8
9. Stakeholders – Section 4.3.9
10. Governance – Section 4.3.10

11. Maturity models – Section 4.3.11
12. Innovations – Section 4.3.12
13. Benefits – Section 4.3.13

The analysis was carried out with support from the Mendeley and XMind tools. The summaries of the analyzed papers is presented in Appendix C.

4.3.1. Attribute 1 – Values

The Values Attribute captures what urban citizens and other city stakeholders expect to achieve from Smart City initiatives, i.e. what needs are important to them and what are acceptable ways of fulfilling such needs through Smart City initiatives. The Values Attribute is part of the Smart City context and is likely to change together with this context. A number of research papers further elaborate and in some cases provides concrete values to the Values Attribute. These research inputs are described below and summarized in Figure 24.

Improving sociable qualities of a city and increasing the citizens' sense of belonging can be pursued by enriching urban social interactions with new technologies and by relying on Smart City infrastructure to empower social activities and enhance citizen participation (Christopoulou, Ringas, and Garofalakis 2014). Collaborative Smart City platforms can help generate social capital through inclusive decision-making, making it easier to institutionalize civic values for regeneration and self-sustainability of urban regions (Deakin and Al Waer 2011)302-320. The use of Smart City e-learning platforms to integrate knowledge transfer and capacity building can allow citizens, communities and organizations to collaborate in consensus, competency and skill-building for developing and regenerating sustainable urban regions (Allwinkle and Cruickshank 2011). The Smart City can give voice to citizens, gather them around collective goals, and involve in neighborhood-related issues (Hosio, Goncalves, and Kukka 2014). The incorporation of green urban plans and design strategies can result in more progressive, innovative and sustainable Smart Cities (Ercoskun 2010). Finally, from experience, issues like equity, inclusion, urban policy, user-driven innovation, integration and converging city infrastructure, Smart City implementation, sustainability and efficiency are current and hot topics in any Smart City agenda.

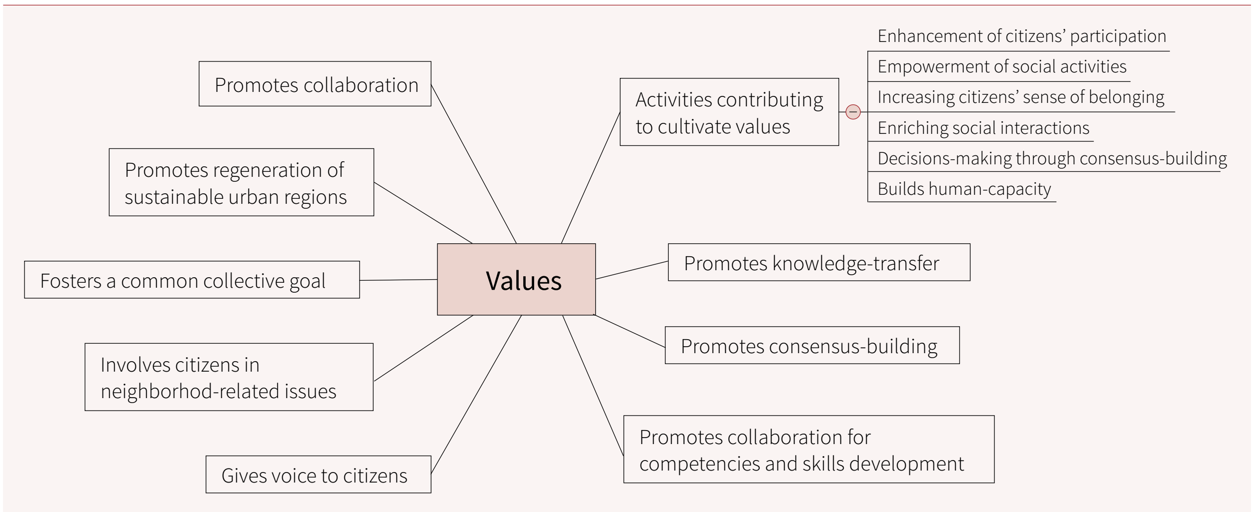

Figure 24: State of Research Qualitative Analysis, Attribute 1 – Values

4.3.2. Attribute 2 – Drivers

The Drivers Attribute represents the factors that motivate, provide an impulse and enable the establishment and implementation of Smart City initiatives. Like the Values Attribute, Drivers are part of the Smart City context and are likely to change together with the context. A number of research papers provide further characterizations, describes possible approaches, and in some cases provides concrete values to this attribute. These research inputs are described below and summarized in Figure 25.

The optimization of city operations, the improvement of citizens' quality of life and pursuing sustainable development are some of the main priorities of the Smart City concept (Sánchez et al. 2013). In addition, the main drivers include: building an image of modernity and smartness for city marketing campaigns; developing science parks, tech-cities and techno-pole centers; developing municipal and urban services using digital technology; improving economic and political efficiency; enabling social, cultural and urban development; developing an higher urban intelligence using digital technology to optimize urban management; and developing new forms interaction with citizens to foster their participation in decision- and policy-making processes (Batty et al. 2012). The characteristics of Smart City drivers include: the utilization of digital technology for city development; emphasis on business-led development; high-tech and creative industries for long-term growth; human capital in city development; and social, economic and environmental sustainability (Caragliu et al. 2011). The main driving forces for Smart City construction are the state and municipal governments, and enterprises (Glebova 2014).

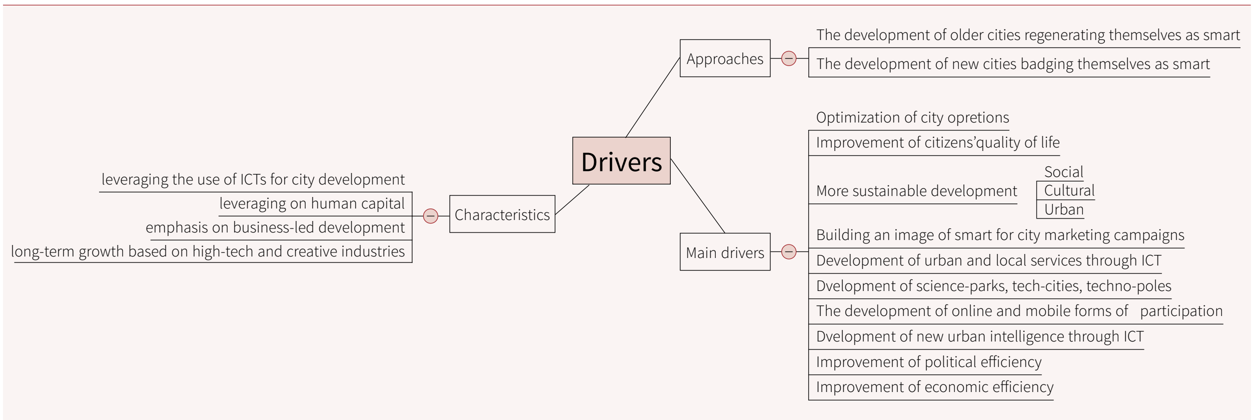

Figure 25: State of Research Qualitative Analysis, Attribute 2 – Drivers

4.3.3. Attribute 3 – Challenges

The Challenges Attribute represents the barriers and obstacles related to the establishment and implementation of Smart City initiatives, due to the social, economic, political, etc. environment. Like Values and Drivers, Challenges is part of the Smart City context and is likely to change together with this context. A number of research papers further elaborate and in some cases provides concrete values to this attribute. These research inputs are described below and summarized in Figure 26.

With the advent of Smart City, several technological, social, economic and environmental challenges arose at different levels (Ercoskun 2010). At the technological level it is necessary to develop an integrated city infrastructure and an integrated platform at the top for operational functions, management, and control, and optimize resources use; to optimize such use, all systems must be integrated but this integration of city systems into one self-adaptable and self-managed "system of systems" working efficiently and autonomously is missing. The effective integration of city systems remains a challenge due partly to different discourse used by technology- and policy-makers, making difficult the dialogue and reaching consensus about the best technology solutions. The challenge goes well beyond technology and economy as a cultural change is also required to build sustainable Smart Cities.

Specific technological challenges include machine-to-machine communications, security, spectrum utilization, intelligent information networks, and interconnection of a set of standards to achieve system interoperability. At the social level, the main challenges are: reinforcement of social and territorial cohesion; ensuring equity, fairness and the existence of active labor markets; provision of better quality of life; and improvements in citizen involvement, interaction and participation in political and decision-making process (Ojo, Curry, and Janowski 2014). A challenge is also to define suitable quality of life indicators for policymakers to help improve city life and to benchmark the efforts by different cities (Craglia et al. 2004). At the economic level, the key challenge is improving the competitiveness of the local economy against international markets to develop a Smart City strategy with knowledge of its relative position in the global urban networks (Tranos and Gertner 2012). At the environmental level, the main challenge is to assure environmental sustainability by making decisions that protect the natural environment and make efficient use of available resources, or, at least, reduce the impact of such decisions (A. Mulligan and Olsson 2013) (Yamauchi, Kutami, and Konishi-Nagano 2014).

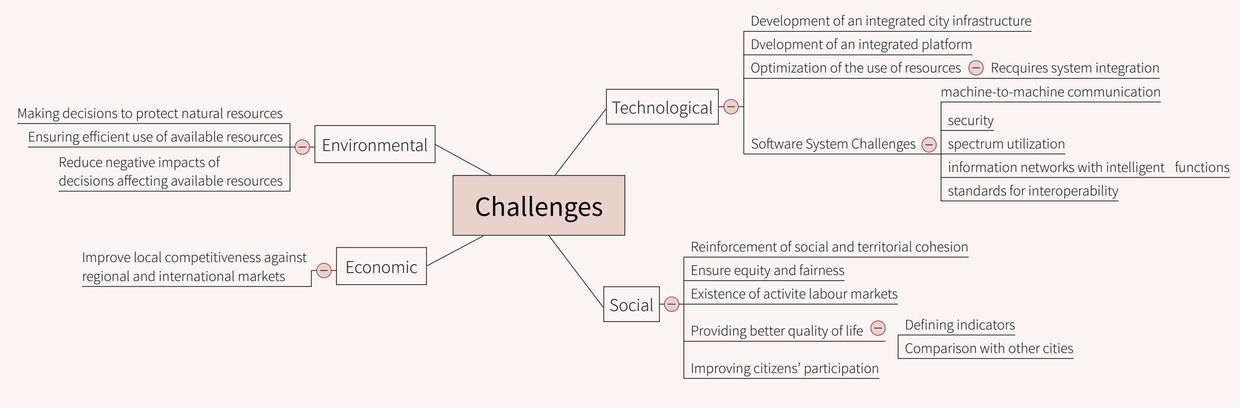

Figure 26: State of Research Qualitative Analysis, Attribute 3 – Challenges

4.3.4. Attribute 4 – Risks

The Risks Attribute represents possible occurrence of undesirable and potentially damaging consequences of Smart City initiatives and how such consequences could be avoided, minimized or managed. Like Values, Drivers and Challenges, the Risks Attribute is part of the Smart City context and is likely to change together with this context. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 27.

The development of a Smart City is not a simple mathematical sum of smart features; the policies, technologies and plans must be oriented towards common objectives, otherwise the risk of Smart City development being compromised will be considerable (Perillo 2013). The implementation of Smart Cities should not be driven by specific and personal objectives, strategies, ideologies and interests, or by restrictive visions centered in technological solutions without taking into account social-environmental concerns, i.e. neglecting the legal, social and ethical impact of technologies (Galdon-Clavell 2013) (Anttiroiko, Valkama, and Bailey 2013). Smart City development requires interdisciplinary work, critical analysis of best practices, knowing the requirements, understanding the engineering processes and introducing risk modelling (Liu, Wei, and Rodriguez 2014). It is important to know the risks and the social, economic and environmental benefits associated with different Smart City features.

In order to avoid potential risks in Smart City development, the following should be taken into account (Bianchini and Avila 2014) (Granath and Axelsson 2014) (Nam and Pardo 2014): clearly identifying hidden risks behind decisions, mainly when they are only justified with technical arguments; guaranteeing independent and equal access to administrative and justice services; avoiding the manipulation of information and the resulting distortion of reality; avoiding biased information that could overshadow the real benefits of Smart Cities; introducing ethical dimension in all decision and operational processes; considering human rights implications and technological risks; avoiding lack of communication between city and citizens and ill-informed citizens; avoiding the risk that Smart City pursues economic goals without addressing sustainability concerns; discussing the use of digital technology in different contexts to avoid counterproductive and unsustainable technological solutions; analyzing infrastructure costs, ecological concerns and political limitations; addressing the risk of surveillance and invisible networks threatening citizens; resolving data security, data sharing and ethics problems; and mitigating inter-organizational tension and conflicts.

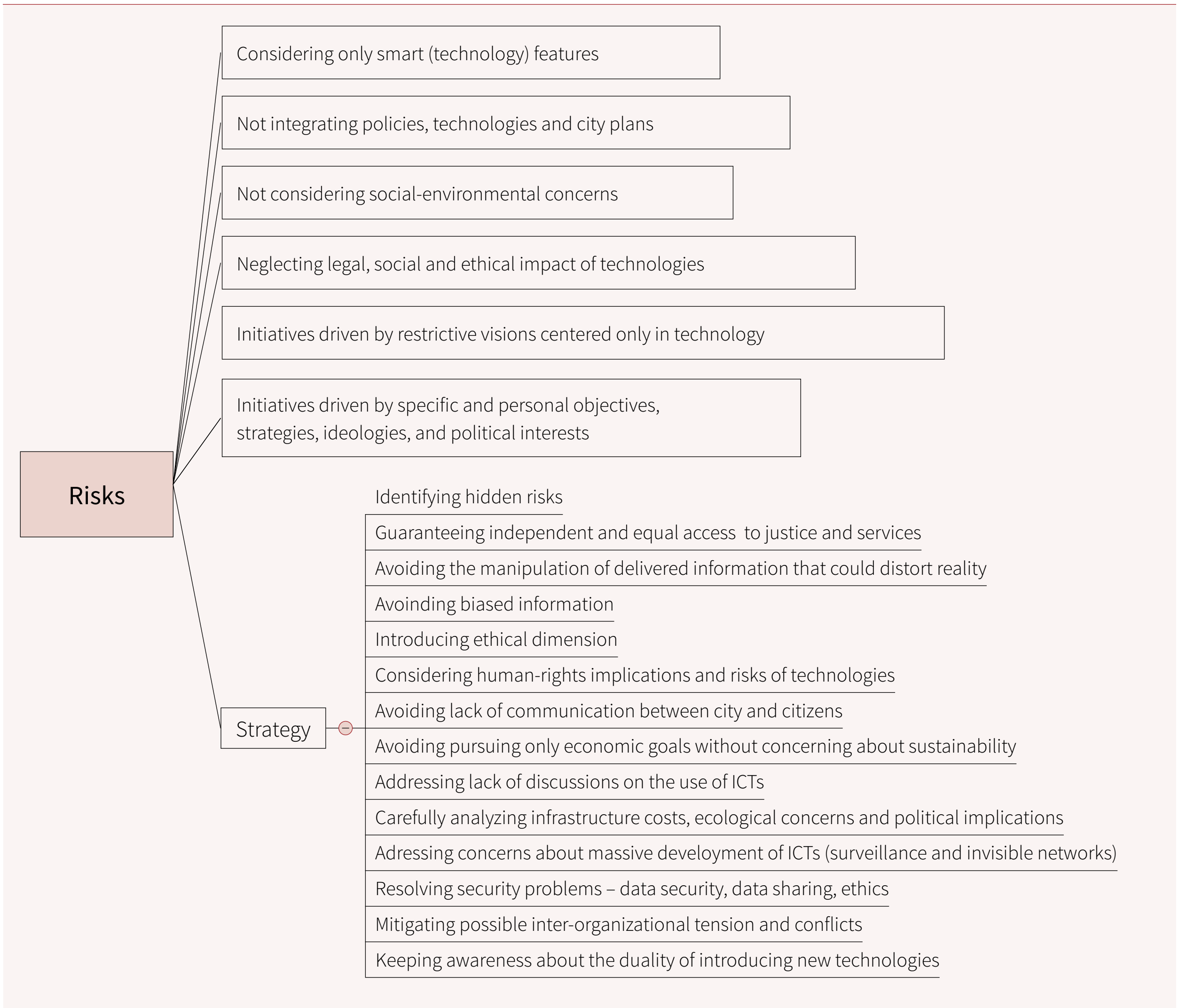

Figure 27: State of Research Qualitative Analysis, Attribute 4 – Risks

4.3.5. Attribute 5 – Regions

The Regions Attribute represents how a city's Smart City initiatives are informed by its history and unique path to development, and how they could be benchmarked against other cities in the region. Like Values, Drivers, Challenges and Risks, the Regions Attribute is part of the Smart City context and likely to change together with it. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 28.

Smart City initiatives are intrinsically related to the city's organizational culture, priorities, objectives and strategic vision (Odendaal 2003). The problems to tackle are different from region to region, varying according to industrial and political history, culture, geography, topology and local, national and international policies (Dodgson and Gann 2011). The city's economic development, its urban structure and geography, human capital, and citizens' needs and aspirations also influence the Smart City strategy (Kakarontzas et al. 2014). The city should be framed into the local characteristics and conserve the urban heritage as its identity but it should be also aware of its inter-urban dependencies because it is not possible to develop a smart strategy without knowing the relative position of the city in the global urban network (Weinstock and Gharleghi 2013). Regarding technological development, an organization that will deliver technology for a Smart City project should develop a specific and appropriate solution to the reality of the city in question (Paroutis, Bennett, and Heracleous 2014).

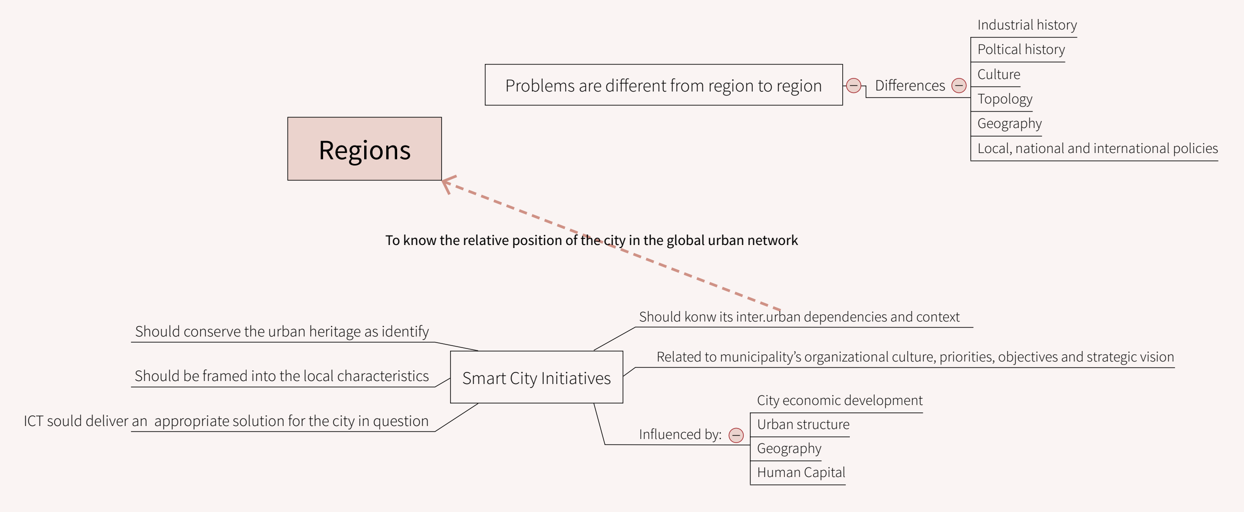

Figure 28: State of Research Qualitative Analysis, Attribute 5 – Regions

4.3.6. Attribute 6 – Technologies

The Technologies Attribute represents the presence of disruptive digital technologies, how they can generate public value, and what is required to apply them in the Smart City context. Unlike previous attributes, the Technologies Attribute is not part of the Smart City context, but an input to Smart City transformation. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 29.

According to (Schaffers et al. 2012), the Smart City concept is a new approach to urban development, focused on how digital technology can be used to enhance citizens' quality of life. These technologies include mobile phones, sensor networks, big data, grids, cloud services, Internet of Things, etc. all joined to the common Internet infrastructure to enable the interconnection of people, objects and city systems around a city platform. In order to lead to successful Smart City implementations, this interconnection requires systems thinking and continuous engineering (Amaba 2014). It is possible to forecast a ubiquitous city with technological equipment and pervasive services for citizens (Gabrys 2014). A real promise of Smart City initiatives is that digital technologies can be used to enhance equity and fairness and to promote citizen participation and social inclusion in the urban space (Kourtit, Nijkamp, and Arribas 2012). Technological trends relevant to Smart City initiatives include open source software, web services, geo-informatics and ubiquitous technologies (Anttiroiko et al. 2013).

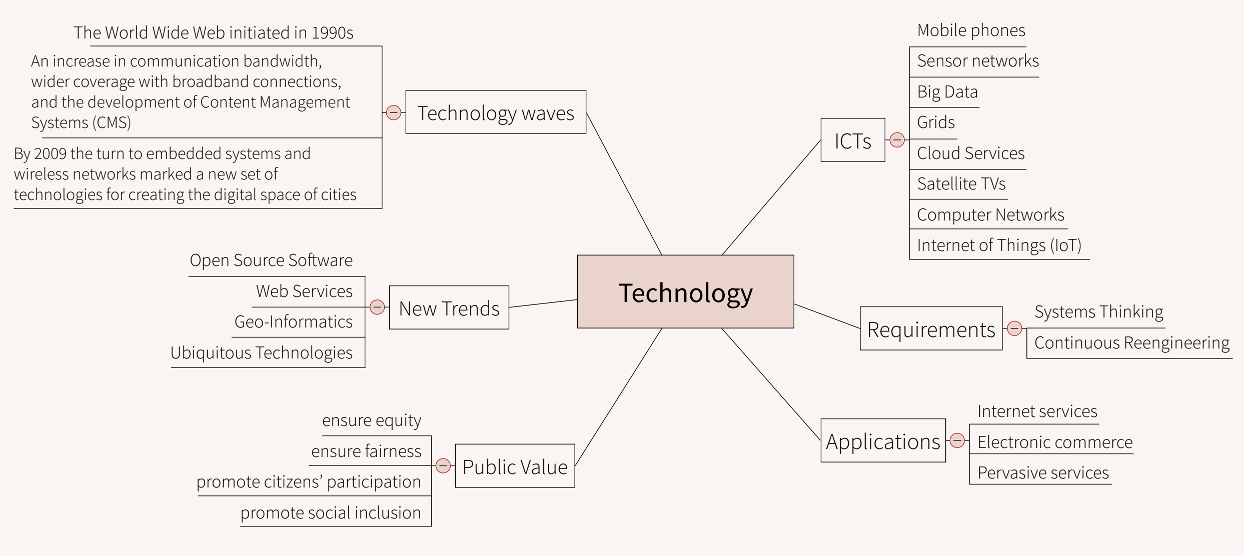

Figure 29: State of Research Qualitative Analysis, Attribute 6 – Technologies

4.3.7. Attribute 7 – Tools

The Tools Attribute represents various conceptual, technical and methodological guides and instruments, many available on digital platforms, to support planning and implementation of Smart City initiatives. Like Technologies, the Tools Attribute is an input to Smart City transformation. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 30.

A Smart City model is a tool for city modernization and social mobilization driven by a set of urban development goals. In addition, simulation, modelling and virtual reality tools could help in the creation of Smart Cities (Dodgson and Gann 2011). Such tools enable predicting the behavior of real city systems to better plan and design the future Smart City systems (Wenge et al. 2014) (Cohen, Money, and Quick 2014). The living labs and test beds are also powerful tools to view how user-driven open innovation could be organized and influence Smart City development (Schaffers et al. 2012) (Veeckman and van der Graaf 2014). The massive sensing and data collection through sensor networks could help understand how city works and to improve services to citizens with context-aware information. An example is the "Innovation Technology" tool that enables the virtualization of city systems and services (Gann, Dodgson, and Bhardwaj 2011). The capacity to virtually represent cities, plans and options leads to better understanding of strategies and designs, and enables the implementation of more sustainable city solutions.

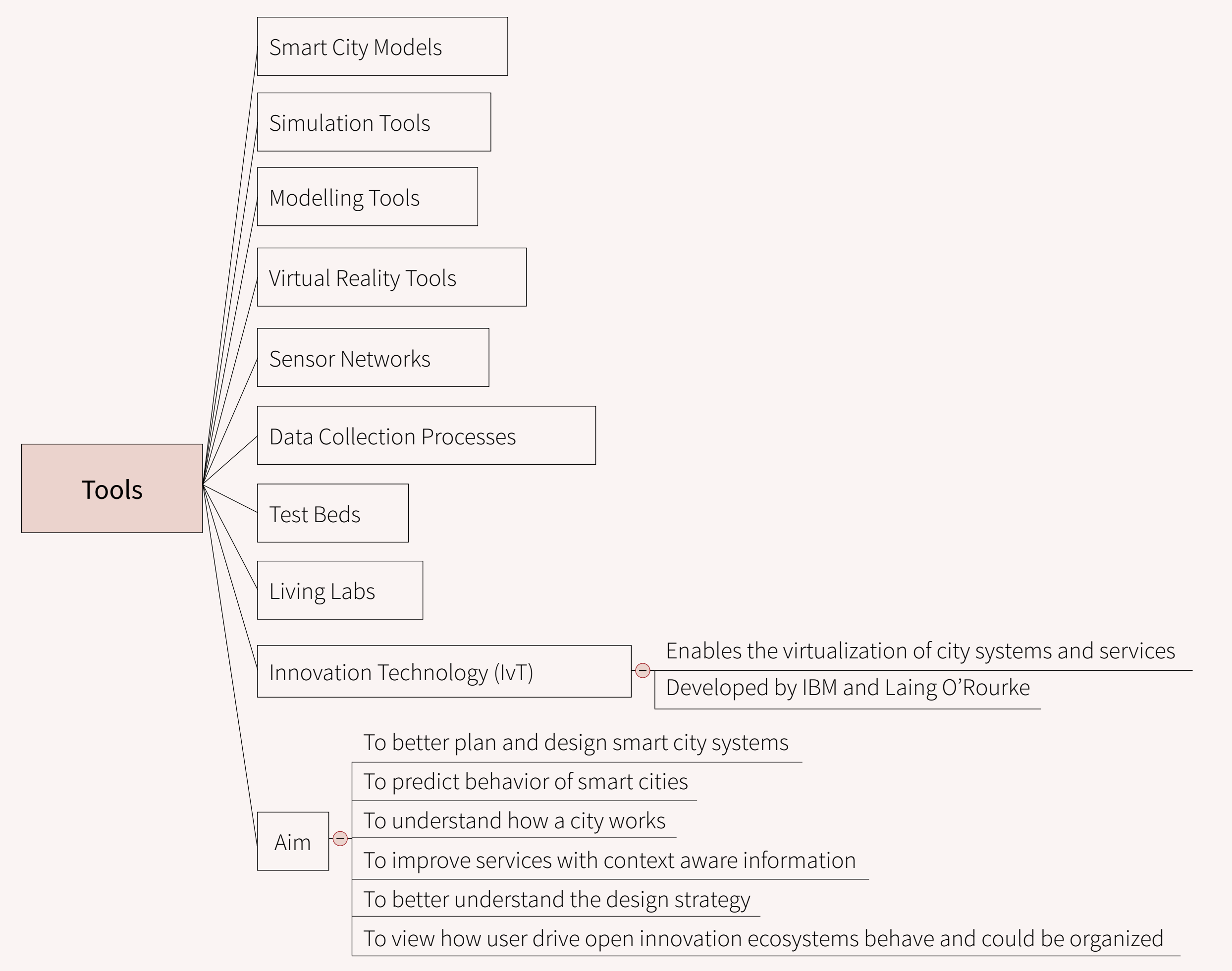

Figure 30: State of Research Qualitative Analysis, Attribute 7 – Tools

4.3.8. Attribute 8 – Approaches

The Approaches Attribute represents the fundamental decisions, supported by practical, methodological or even philosophical arguments, concerning how Smart City transformation will be planned and carried out. Unlike Technologies and Tools, the Approaches Attribute is not part of inputs to Smart City transformation, but part of the transformation itself. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 31.

Two fundamental approaches to the planning and implementation of Smart City initiatives are top-down and bottom-up (Veeckman and van der Graaf 2014). In the top-down approach, city government drives the Smart City implementation strategy, accompanied by incentives, funding and publicity to help adoption of Smart City plans. This approach tends to lead to a more technical vision of Smart City implementation (Lee, Hancock, and Hu 2013). In the bottom-up approach, planning processes are based on contribution from citizens, creative communities, research institutions and the private sector, and market-oriented partnerships between public and private sectors are created to support sustainable city development. This approach tends to lead to greater engagement of citizens with the Smart City strategy because they are more involved in decision-making process (Schaffers et al. 2012). The bottom-up approach, driven by citizens and enterprises, seems to be consensual in the literature. The role of governments is to facilitate consensus-building and act as a mediator between all parties concerned. However, bringing the Smart City subject into the political arena to discuss different priorities and possible development alternatives is important.

No matter which approach is used, there are currently few cases of Smart City strategies and their outcomes. Furthermore, there is no clear vision on how Smart Cities are being implemented in practice and what are the best policies and strategies to explore the digital infrastructures. A review of best practices for Smart City implementations is fundamental to learn from the past before the implementation of new Smart City projects takes place (Girard 2013).

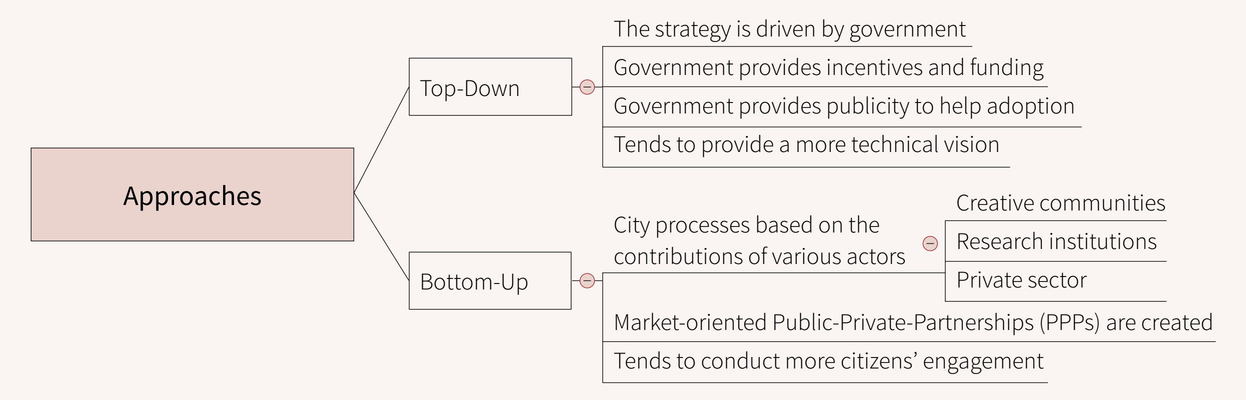

Figure 31: State of Research Qualitative Analysis, Attribute 8 – Approaches

4.3.9. Attribute 9 – Stakeholders

The Stakeholders Attribute represents all parties, including public, private and voluntary sectors with interest and concern in Smart City initiatives and their progress and outcomes. Like Approaches, the Stakeholders Attribute is part of Smart City transformation. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 32.

Engaging relevant stakeholders, both public and private, around common city objectives is a crucial requirement for the success of Smart City projects. Sustainable Smart Cities will emerge from strong public-private partnerships, which partnerships coordinate the use of city resources and the organization of city activities in dynamic, open and innovative ways (Komninos, Pallot, and Schaffers 2012). Given the variety of actors involved in Smart City projects, the collaboration, networking and interaction between all partners is fundamental (Schaffers et al. 2012). A Smart City developed on the basic level of maturity has three main stakeholders: municipality including different municipal departments as the project owner; enterprises as project performers; and strategic partners including research institutions and Internet, energy, water and other media providers (Granath and Axelsson 2014). Smart Cities should involve citizens as the main stakeholders, engaging them in the design of city projects and services through crowdsourcing, social networks, gamification and other interactive technologies (Schuurman et al. 2012). The Smart City concept also introduces the notion of customers as stakeholders to include citizens, visitors and organizations. In order to provide the best services to customers, their different needs and preferences should be taken into account in planning and design of Smart City projects (Steyaert 2000). As Smart City projects have a vision of economic growth and are oriented on environmental, economic and social sustainability goals, paying special attention to the quality of life issues, collaboration among different industries and national and local governments is required.

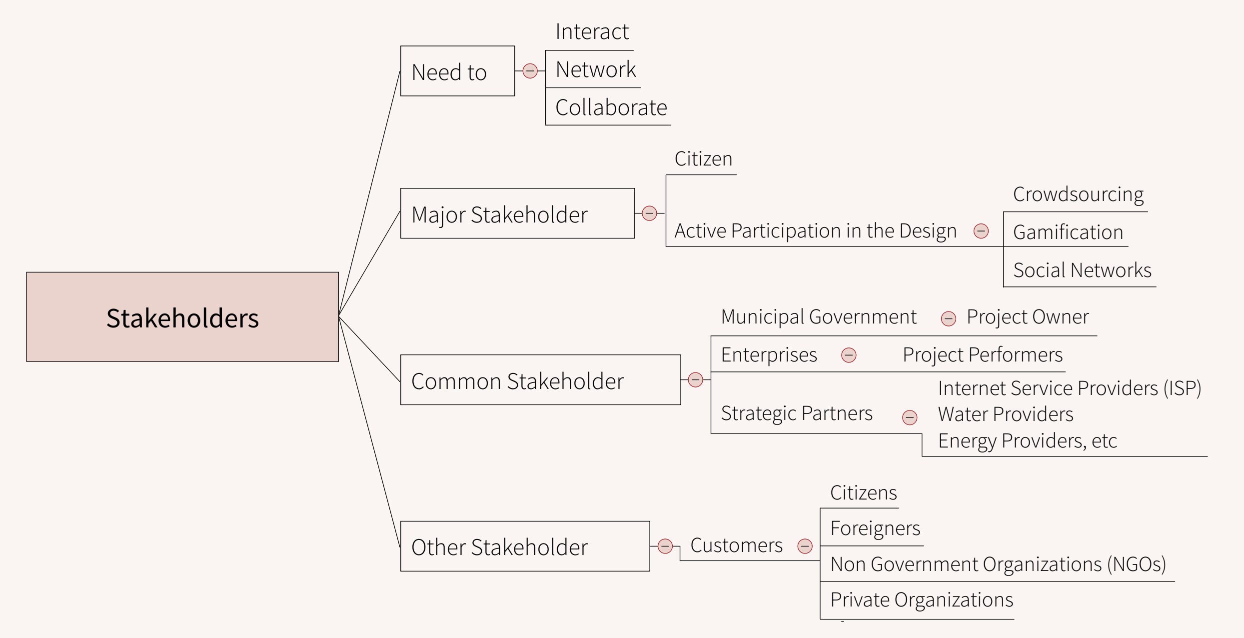

Figure 32: State of Research Qualitative Analysis, Attribute 9 – Stakeholders

4.3.10. Attribute 10 – Governance

The Governance Attribute represents how the Smart City government operates, how it manages public funds, how it delivers public infrastructure and services, how it supports sustainable city development, and how it engages its citizens in decision-making processes. Like Approaches and Stakeholders Attributes, the Governance Attribute is part of Smart City transformation. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 33.

The public governance in a city and the delivery of public services should be provided in efficient, effective, transparent, open and collaborative ways (Kitchin 2013). Centralized and comprehensively strategized e-governance should allow for more effective and optimized coordination and control of Smart City functions and operations (Lee et al. 2013). Organizational integration with digital platforms is essential to enhancing local government and the creation of one central agency to drive e-governance operations is a possible option to achieve such integration (Odendaal 2003). Some of the key aspects of governance include a strong Smart City leadership operating within a well designed governance model; a centralized Smart City strategy with a holistic view in the city; a dedicated organization for the development of Smart City projects; resilient decision and implementation processes; governance principles; and performance measurements of city services (Lee and Hancock 2012).

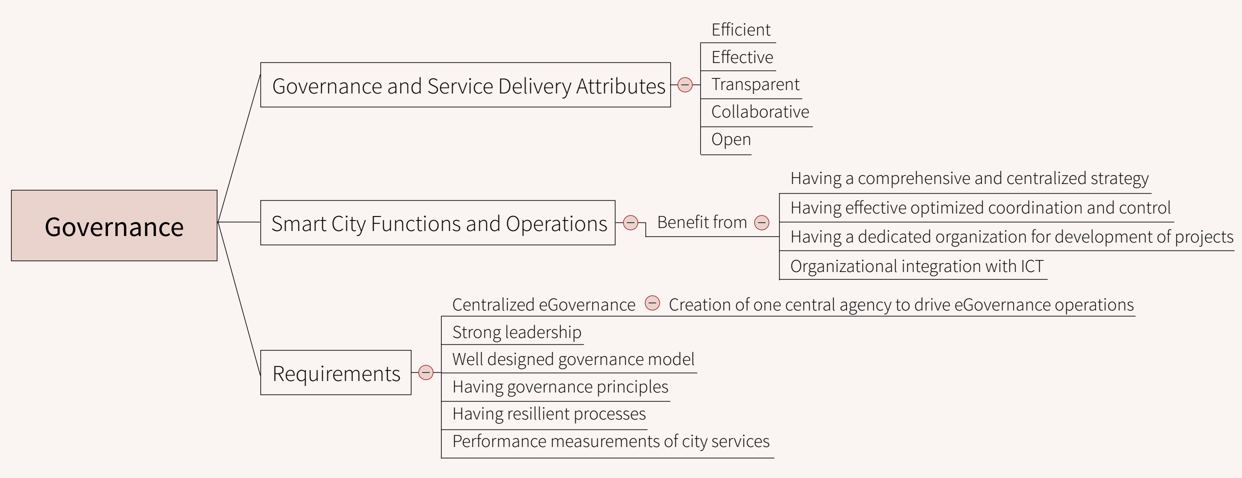

Figure 33: State of Research Qualitative Analysis, Attribute 10 – Governance

4.3.11. Attribute 11 – Maturity Models

The Maturity Models Attribute represents the advancement of Smart City development along a series of discrete maturity stages, the achievement of higher stages representing a significant advancement compared to the lower stages. Like the Approaches, Stakeholders and Governance Attributes, the Maturity Models Attribute is part of Smart City transformation. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 34.

Assessing the level of Smart City maturity requires models to measure the level of smartness of a city, and require defining levels of maturity for comparing cities that pursue similar smartness objectives (Maccani, Donnellan, and Helfert 2014). A Smart City maturity model, besides assessing the readiness of a city for Smart City transformation, guides the choice of the city's priority domains and build the guidelines for Smart City implementation.

Developed by IBM, a set of tools for understanding the situation of a city and designing Smart City plans includes: 1) Smarter City Assessment to collect information about operating systems; 2) Smarter City Maturity Model to assess and build a road map for the city; 3) Smarter City Actionable Business Architecture to define the relationships between different city domains, e.g. strategy, operating and technology; and 4) Municipal Reference Model to describe a set of concepts, tools, and services offered by the city (Huestis and Snowdon 2011).

The Scottish Government developed a Smart Cities Maturity Model and a city self-assessment tool (The Scottish Government, Scottish Cities Alliance, and UrbanTide 2015). The Maturity Model comprises six maturity levels: ad-hoc, opportunistic, purposeful, repeatable, operationalized and optimized, evaluated considering five dimensions: strategic intent, data, technology, governance and service delivery models, and citizen and business engagement. The stages of the self-assessment tool determine the level of maturity achieved in different dimensions and to what extent these dimensions should be further developed. The Self-Assessment Tool has three stages that must to be assessed by filling a questionnaire.

The Indian Government developed a Smart City Maturity Model to establish metrics to assess the smartness of the Indian cities and their readiness for Smart City projects (Sustainable Business Leadership Forum 2014). The model has four levels from basic urban services to high urban resilience: access, efficiency, behavior and systems focus. The model was applied to transport, spatial planning, water supply, sewerage and sanitation, storm water drainage, solid waste management, electricity, telephone connections, and Wi-Fi connectivity.

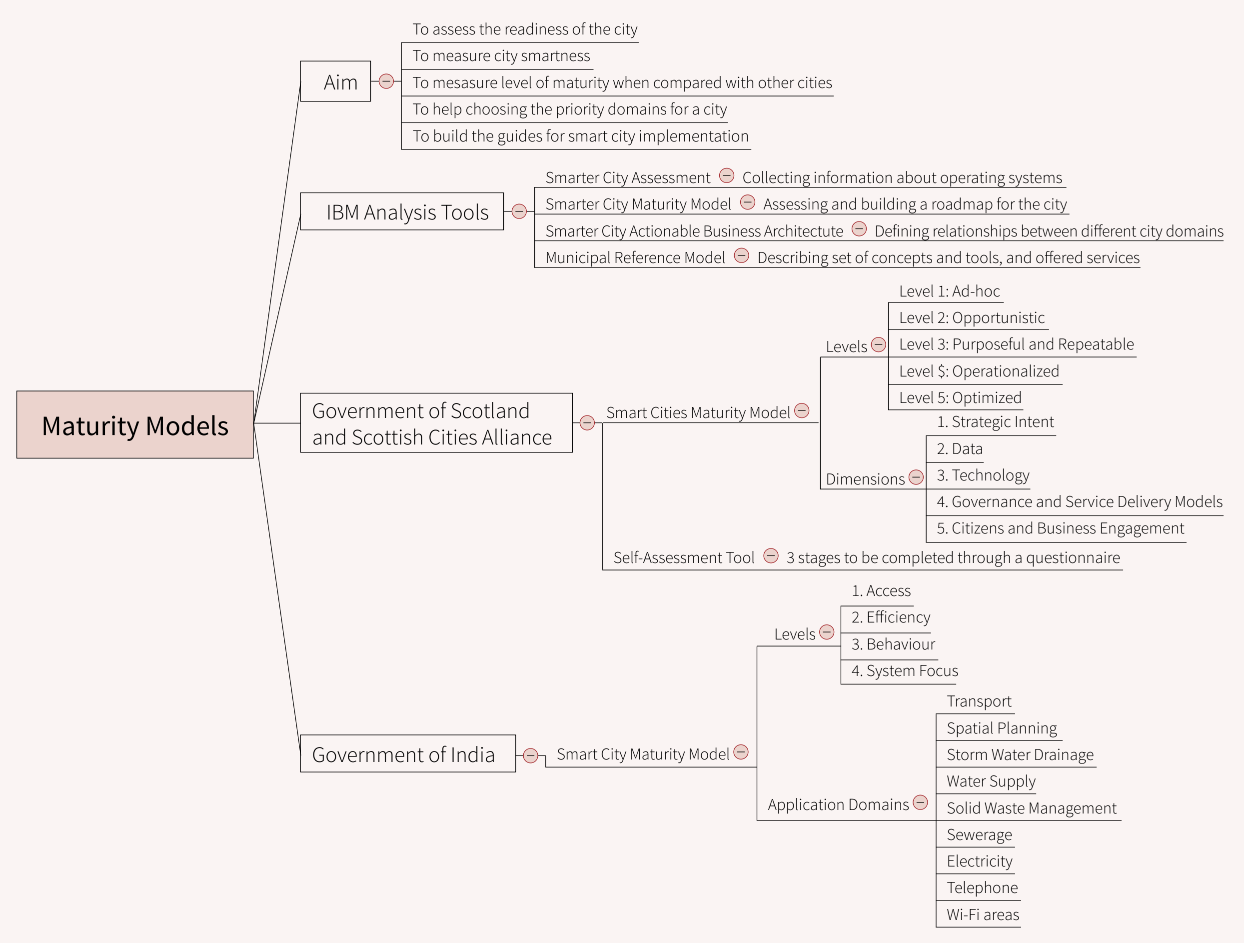

Figure 34: State of Research Qualitative Analysis, Attribute 11 – Maturity Models

4.3.12. Attribute 12 – Innovations

The Innovations Attribute represents the capacity of a Smart City for creating and realizing new ideas, processes, services, etc. around the use of digital technologies to address existing needs or utilize new opportunities and create an impact on the city. Unlike the Approaches, Stakeholders, Governance and Maturity Models Attributes that belong to Smart City transformation, the Innovations Attribute belongs to Smart City outcomes. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 35.

A Smart City could be understood as an open ecosystem that hosts user-driven innovation processes where citizens create and foster innovations to improve their quality of life. Within this concept, innovation is a new way of performing city operations to pursue significant improvements in health care, social inclusion, environment, business and other areas. However, there is little experience in building innovative processes in complex systems with significant numbers of variables like Smart Cities (Dodgson and Gann 2011). To ensure sustainable urban futures, cities should innovate in internal planning, management and operations (Zygiaris 2012) (Naphade et al. 2011). The resources required to realize Smart City as an innovation laboratory include test beds, living labs and crowdsourcing (Schuurman et al. 2012) as well as user communities. In particular, test beds and living labs are useful tools for deploying, organizing and comparing user-driven open innovation ecosystems (Schaffers et al. 2011). To foster the creation of innovation ecosystems, governments could create incentives and provide policy support to the industries related to technological innovation (Wang, Chen, and Zheng 2014).

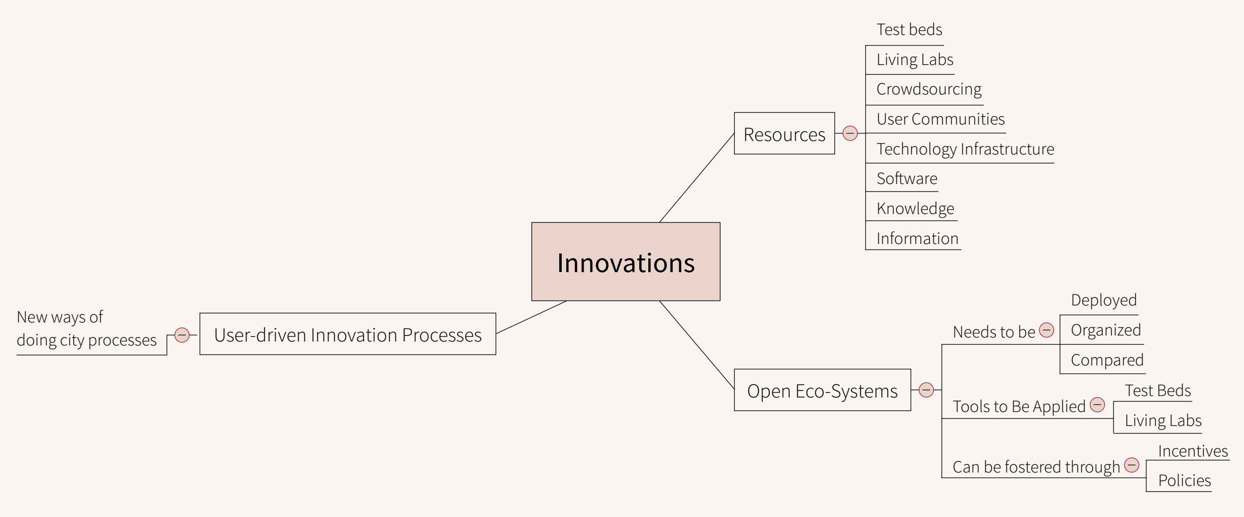

Figure 35: State of Research Qualitative Analysis, Attribute 12 – Innovations

4.3.13. Attribute 13 – Benefits

The Benefits Attribute represents a range of positive outcomes obtained by the city and its various stakeholders, directly or indirectly due to its transformation into a Smart City. Like Innovations, the Benefits Attribute belongs to Smart City outcomes. A number of research papers further elaborate and provide concrete values to this attribute. These research inputs are described below and summarized in Figure 36.

At its origin, the Smart City concept is an urban development strategy that relies on digital technology to enhance citizens' quality of life and allow them to become innovation agents. The main benefits of a Smart City is to foster economical and sustainable development of cities while protecting their environment (Kurebayashi et al. 2011). The benefits of Smart Cities for citizens include enhanced quality of life, good public transport, efficient management of urban space and communications (Dewalska–Opitek 2014). The creation of an intelligent human society inhabiting Smart Cities and powered by digital technology, allows the development of sustainable cities in terms of environmental protection and economic and technological growth (Uzumaki 2014). In addition, the pervasive characteristic of data and services offered by digital technologies like e.g. the Internet of Things could help to bind disperse and separate communities, improve the interaction and involvement of citizens, offer new and enhanced city services, and provide a holistic and context-aware view on city operations (Walters 2011).

According to (Kessides 2013), expected benefits of Smart Cities for citizens, local authorities, local economy and various intersections of these domains include: 1) for citizens – flexibility, social cohesion, lifelong learning opportunities, better community connectivity, improved health conditions and independence, and increased employment opportunities; 2) for local authorities – cost reduction, improved government transparency, increased collaboration, improved decision making, knowledge dissemination, experience dissemination and improved work efficiency; 3) for local economy – promoting innovation, catalyzing development of products and services, engaging and leveraging small- and medium-size enterprise community, and accelerate new business start-ups; 4) for citizens and local authorities – participation in public life, resilient public services and social equality; 5) for citizens and local economy – increased economic activity; 6) for local authorities and local economy – leveraging public funding and increased inward investment and 7) for all citizens, local authorities and local economy altogether – improved resource efficiency, sustainable mobility, environmental sustainability and economic prosperity.

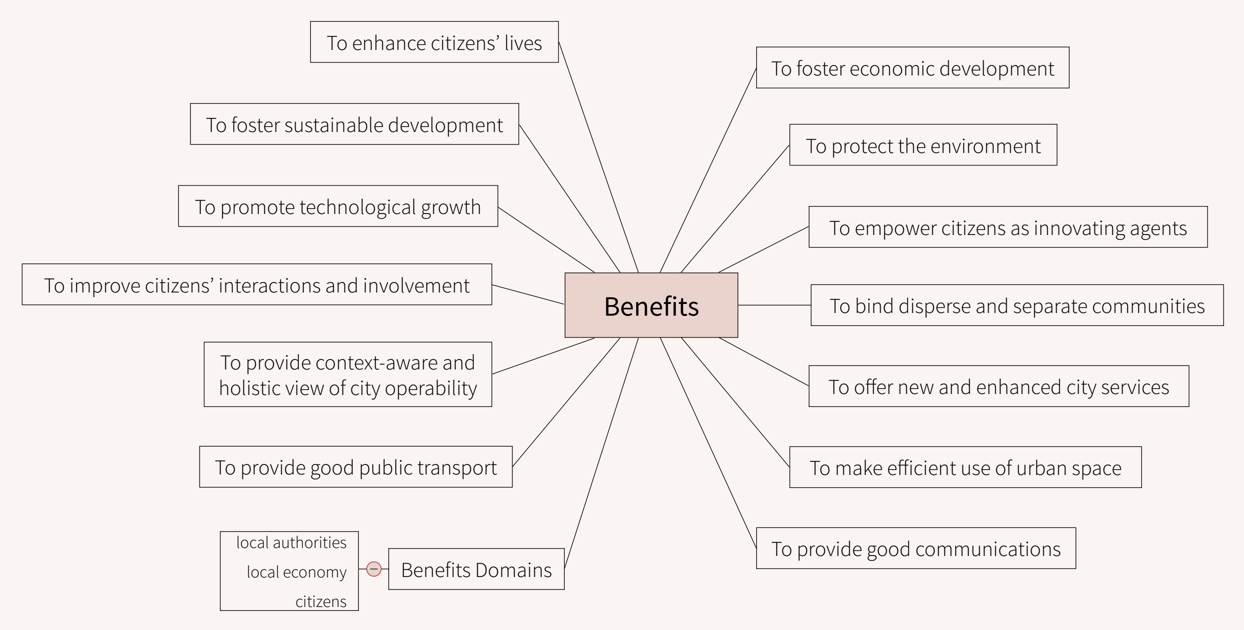

Figure 36: State of Research Qualitative Analysis, Attribute 13 – Benefits

5. Policy Literature Review

This section presents an overview of the Smart City policy literature proposed by relevant think tank, research and international organizations, and governments. The section describes the process applied to carry out data collection in Section 5.1, followed by the quantitative analysis of the Smart City policy organizations including their types, locations, policy mandates and policy areas in Section 5.2, and the qualitative analysis of the relevant Smart City policy literature along 13 Smart City attributes derived from the project's terms of reference, and produced by such organizations in Section 5.3.

5.1. Data Collection

The aim of the data collection task was twofold. First, to identify influential sources of Smart City policy literature including relevant think tank, research and international organizations, as well as governments active in the area. Second, to identify relevant policy literature produced by such organizations that focused on the topic of Smart Cities.

The first step involved conducting a Google search for the relevant organizations using a combination of "think tank", "research center", "smart city" and "Smart Cities" keywords. In total, 51 organizations were identified in this way, and for each organization the information was collected about its name, goal, work areas, location and the webpage. In turn, the work areas involved determining the presence of the organization in one or more of the Smart City dimensions: economy, governance, mobility, environment, living and people. The data was analyzed quantitatively and the findings are described in Section 5.2.

The second step involved exploring directly the websites of the organizations identified in the first step including the World Bank, International Telecommunication Union (ITU), European Commission (EC), International Organization for Standardization (ISO), International Electro-Technical Commission (IEC) and others, to collect information about Smart City policies. In addition, a Google search was conducted for relevant documents using a combination of "smart city", "policy" and "policies" keywords. During this step, nine documents were collected and summarized. The documents were analyzed qualitatively, the findings are described in Section 5.3 and the summaries are included in Appendix D.

5.2. Quantitative Analysis

This section presents the findings of the quantitative analysis of the identified Smart City policy organizations, i.e. think tank, research, international and government organizations active in producing Smart City policy literature.

The analysis starts in Section 5.2.1 by listing the organizations and determining their types and locations, followed by the analysis of the Smart City policy mandates pursued by such organizations in Section 5.2.2, followed by Smart City policy focus covered by them according to well-known six Smart City dimensions, i.e. economy, governance, mobility, environment, living and people in Section 5.2.3.

The tools applied to conduct the analysis presented in this section were: Google Search Engine, Mendeley, XMind, Excel, Wordle and TagCrowd .

5.2.1. Aspect 1 – Policy Organizations

Nine types of organizations were considered:

1. Private – private sector organizations;
2. Academia – academic organizations;
3. Government – government organizations;
4. Non-profit – non-for-profit organizations;
5. InterGov – inter-governmental organizations;
6. PPP – public-private partnerships ;
7. PPPP – public-private-people partnerships;
8. GAP – government-academia partnerships; and
9. APP – academia-private partnerships.

Table 13 lists all 51 identified organizations including their names, types and websites.

Table 13: State of Policy Quantitative Analysis, Aspect 1 – Policy Organization

NO	NAME	TYPE	WEBSITE
1	Reinvent Cities	Private	http://reinventcities.com/
2	Smart Growth America	Private	http://www.smartgrowthamerica.org/advocacy/federal-policy-priorities/
3	The World Bank	InterGov	http://www.worldbank.org
4	World Cities Network (WCN)	Private	http://www.worldcitiesnetwork.org/about-us/
5	Urban Institute	Private	http://www.urban.org
6	Sustainable Cities Collective	Private	http://sustainablecitiescollective.com/about?ref=navbar
7	Intelligent Community Forum (ICF)	Private	http://www.intelligentcommunity.org
8	EY Center for Smart City Innovation	Private	http://www.ey.com/RU/en/Services/Specialty-Services/Smart-City-Innovation-Center
9	Smart Cities Research Center	Academia	http://smartcities.berkeley.edu/about-us/
10	MIT - City Science	Academia	http://cities.media.mit.edu
11	Center for Information & System Engineering (CISE)	Academia	http://www.bu.edu/systems/research/sc-research-highlights/

12	Sustainable Smart Cities Research Center	Academia	http://www.uab.edu/smartcities/
13	Columbia University - Center for Smart Cities	Academia	http://datascience.columbia.edu/smart-cities
14	Centre for IT-Intelligent Energy Systems in Cities (Cities)	Government	http://smart-cities-centre.org
15	Universitat Politècnica de Catalunya(UPC) - Smart Cities	Academia	http://www.upc.edu/research/strategic-areas/upc-smart-cities
16	Trinity Centre for Smart and Sustainable Cities - Future Cities	Academia	https://www.tcd.ie/futurecities/
17	Smart City Institute	Academia	http://labos.ulg.ac.be/smart-city/research/
18	German Center for Research and Innovation	Government	http://www.germaninnovation.org
19	Digital Economy Lab	Academia	http://www3.imperial.ac.uk/digital-economy-lab/researchnetworks
20	INTELI Inteligência em Inovação - Centro de Inovação	Private	http://www.inteli.pt/pt
21	Amsterdam Smart City (ASC)	PPP	http://amsterdamsmartcity.com
22	Smart Cities Council	Private	http://smartcitiescouncil.com/
23	Center for Innovation in Cities	Academia	http://www.esade.edu/research-webs/eng/iik/cic
24	Algoritmi Center- Sustainable and Smart Cities (SSC) thematic strand	Academia	http://algoritmi.uminho.pt/ts-cities/
25	ASH Center for Democratic Governance and Innovation	Academia	http://datasmart.ash.harvard.edu
26	Fraunhofer FOKUS	Private	https://www.fokus.fraunhofer.de/0f17c3f6624c96c8/smart-cities
27	Institute for the Future (IFTF)	Non-Profit	http://www.iftf.org/home/
28	TerraSwarm Research Center	Private	https://www.terraswarm.org/index.html
29	Smart City Innovation Centre	Government	http://www.bjdw.org/index.php/SMART_CITY/29.html?lang=en
30	Hitachi Data Systems	Private	http://www.hitachi.com/rd/portal/research.html
31	SmartCityStudio	Private	http://smartcitystudio.com/
32	Smart America	Government	http://smartamerica.org/about/
33	Center for Urban Science + Progress (CUSP)	PPP	http://cusp.nyu.edu
34	Singapore-ETH Centre (SEC) - Future Cities Laboratory (Research program)	GAP	http://futurecities.ethz.ch/about/sec/
35	Singapore-MIT Alliance for Research and Technology (SMART)	GAP	http://smart.mit.edu
36	ICRI-Sustainable Connected Cities	APP	http://www.cities.io
37	Centre for Sustainable Development (CSD)	Non-Profit	http://csdindia.in
38	Centre for Sustainable Communications - ICT for Sustainable Cities (ICIT)	Academia	https://www.cesc.kth.se/research/ict-for-sustainable-cities-icit-1.446687

39	Centre for IT-Intelligent Energy System in Cities - CITIES	Academia	http://orbit.dtu.dk/en/organisations/centre-for-itintelligent-energy-system-in-cities(f873 390f-c5c8-4ea0-87c0-9925ca873384).html
40	City Futures	Academia	http://www.be.unsw.edu.au/research-centres-and-clusters/city-futures/about-us
41	LSECities	Academia	http://lsecities.net/about/lsecities/
42	Centre for Advanced Spatial Analysis (CASA)	Academia	http://www.bartlett.ucl.ac.uk/casa/about-us
43	Future Cities Catapult	Private	https://futurecities.catapult.org.uk
44	Fraunhofer FCR - FOKUS	Private	http://www.fraunhofer.cl/es/innocity.html
45	Centre de Recherche sur les Communautés Intelligentes (CERCI)	Academia	http://www4.fsa.ulaval.ca/cms/site/fsa/accueil/recherche/chairescentrerecherche/centresgroupesetlabo/cerci
46	Aristotle University of Thessaloniki - Urban and Regional Innovation Research (URENIO)	Academia	http://www.urenio.org/profile/
47	Cisco's 'Smart + Connected Communities'	Private	http://www.cisco.com/web/strategy/smart_connected_communities.html
48	IBM's 'Smarter Cities'	Private	http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/
49	Siemens Intelligent Infrastructure	Private	http://w3.siemens.com/topics/global/en/intelligent-infrastructure/Pages/home.aspx
50	Microsoft - CityNext	Private	http://www.microsoft.com/en-us/citynext/default.aspx#fbid=HWH21Fs2z9p
51	Global Compact Cities Programme	Private	http://citiesprogramme.com/aboutus

As depicted in Figure 37, among the 51 organizations, 20 (38%) are academic organizations, 20 (38%) are private sector organizations, 4 (8%) are government organizations, 2 (4%) are non-for-profit organizations, 2 (4%) are government-academia partnerships, 1 (2%) is an intergovernmental organization, and 1 each are PPP, PPPP and APP partnerships.

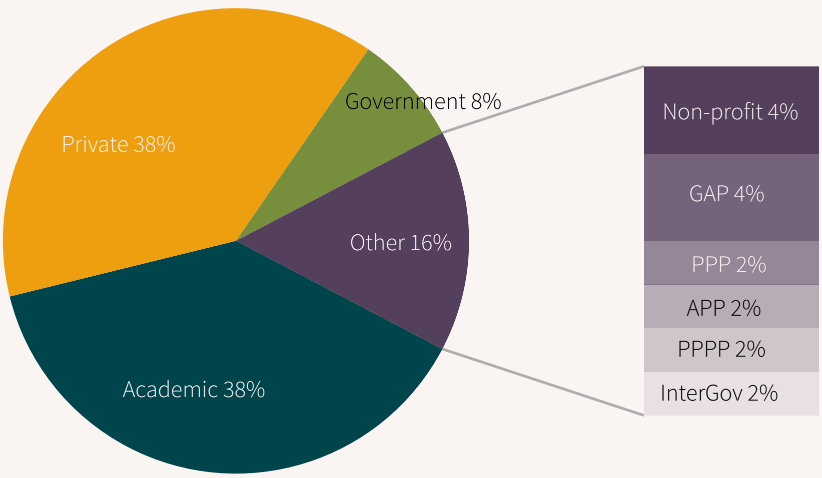

Figure 37: State of Policy Quantitative Analysis, Aspect 1 – Organization Types

The countries hosting the Smart City policy organizations are depicted in Figure 38. The USA stands out with 19 organizations (37%), followed by the UK with 7 (14%); Germany with 3 (6%); Australia, Denmark, Netherlands, Portugal, Singapore and Spain with 2 (4%) each; and Canada, Chile, China, Greece, India, Ireland, Japan, Russia and Sweden with 1 (2%) each. Figure 39 depicts the location of the Smart City policy organizations in developed countries – 47 (92%) organizations based in Australia, Belgium, Canada, Denmark, Germany, Greece, Ireland, Japan, Netherlands, Portugal, Singapore, Spain, Sweden, UK and USA; and in developing countries – 4 (8%) organizations based in Chile, China, India and Russia.

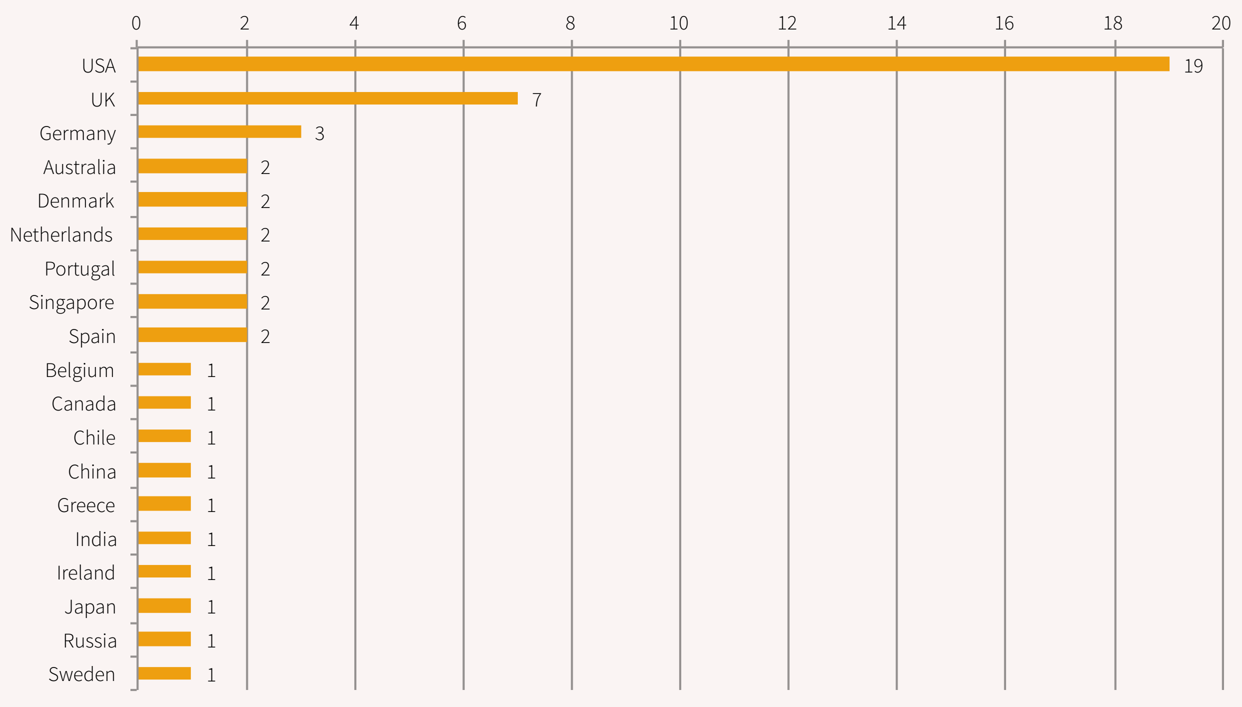

Figure 38: State of Policy Quantitative Analysis, Aspect 1 – Organization Countries

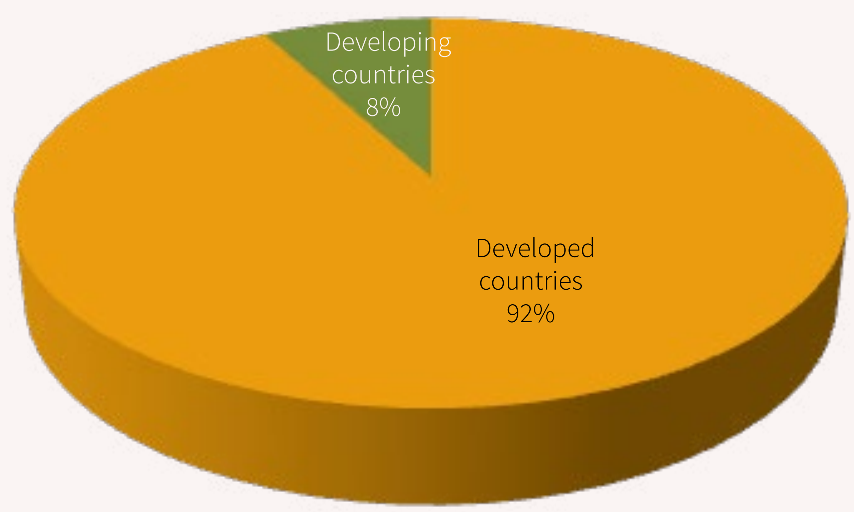

Figure 39: State of Policy Quantitative Analysis, Aspect 1 – Developing versus Developed

5.2.2. Aspect 2 – Policy Mandates

Table 14 presents a list of all 51 Smart City policy organizations identified in Section 5.2.1 along with their official mandates, edited for readability, as published on their websites.

Table 14: State of Policy Quantitative Analysis, Aspect 2 – Policy Mandates		
ID	INSTITUTION	AIM
1	Reinvent Cities	To explore innovative technological solutions for Smart Cities
2	Smart Growth America	To conduct research, and advocate for and lead coalitions to bring smart growth practices to communities
3	The World Bank	To promote innovative and sustainable cities
4	World Cities Network	To improve the resilience of cities
5	Urban Institute	To understand and solve real-world challenges in a rapidly urbanizing environment by engaging communities at city, state and country levels
6	Sustainable Cities Collective	To bring together leaders of major metropolitan areas, as well as urban planning and sustainability professionals
7	Intelligent Community Forum	To study and promote best practices for the Broadband Economy
8	EY Center for Smart City Innovation	To establish thought leadership in Smart Cities and intelligent communities innovation areas in Russia and the Commonwealth of Independent States countries; to provide advice on the creation of strategies and implementation plans based on global lessons learned
9	Smart Cities Research Center	To advance quantitative modelling of urban systems, and to carry out fundamental research in the broad area of Smarter Cities
10	MIT - City Science	To provide new insights into creating a data-driven approach to urban design and planning.
11	Center for Information & System Engineering	To develop concepts, systems and applications designed to make city life more efficient, cleaner, safer and less costly than ever before, and to explore economic, environmental and public policy implications
12	Sustainable Smart Cities Research Center	To understand and transform the impact of urbanization at the scientific, economic, and human levels
13	Columbia University - Center for Smart Cities	To develop and monitor sustainable urban infrastructure and buildings, to improve power supply through smart grid technology, to detect and counteract problems with aging urban infrastructure, to calculate and communicate optimal transportation routes under congested traffic conditions, and to deploy ubiquitous sensing devices to facilitate everyday activities in a crowded urban environment
14	Centre for IT-Intelligent Energy Systems in Cities	To establish a realistic and concrete pathways to achieving independence from fossil fuels by harnessing the latent flexibility of the energy system through intelligence, integration and planning focusing on city needs and working towards both 2020 and 2050 European and Danish goals
15	Universitat Politècnica de Catalunya - Smart Cities	To drive strategic projects in the Smart Cities sector based on leadership and expertise in research projects
16	Trinity Centre for Smart and Sustainable Cities - Future Cities	To undertake multi-disciplinary research that enables, promotes and facilitates behavioral change for sustainability, supported by the application of sensor, communication and analytical technological solutions to sustainability concerns in urban infrastructure such as energy, water, waste management and transportation systems
17	Smart City Institute	To develop scientific expertise – with an international perspective and impact – on the management of Smart Cities
18	German Center for Research and Innovation	To conduct and internationalization science, research and innovation

19	Digital Economy Lab	To act as a portal for all research, teaching and engagement at Imperial College London
20	INTELI Inteligência em Inovação – Centro de Inovação	To define, develop and implement innovation policies, in order to contribute to creative and innovative society, envisaging a sustainable economic and social development
21	Amsterdam Smart City	To develop the Amsterdam Metropolitan Area into a Smart City.
22	Smart Cities Council	To promote the move to smart and sustainable cities through advisory and market accelerator roles
23	Center for Innovation in Cities	To carry out research on analyzing, proposing or inspiring solutions to improve the management of cities
24	Algoritmi Center- Sustainable and Smart Cities (SSC)	To develop innovative technological, economic, social, environmental and wellbeing-related integrated solutions to complex urban centers
25	ASH Center for Democratic Governance and Innovation	To catalyze the adoption of data projects on the local government level and to serve as a central resource for cities interested in this field
26	Fraunhofer FOKUS	To design interoperable, user-friendly infrastructures as well as to launch new innovations for these infrastructure and act as an advisor as a product-independent research institution
27	Institute for the Future (IFTF)	To provide practical foresight for a world undergoing rapid change
28	TerraSwarm Research Center	To address the potential and associated risks of pervasive integration of smart, networked sensors and actuators into connected world
29	Smart City Innovation Centre	To provide design and management consulting service for Smart City pilots in planning, development, operation and maintenance
30	Hitachi Data Systems	To realize Smart Cities as sustainable next-generation cities
31	SmartCityStudio	To develop concepts and designs which make cities cleaner, safer, more efficient, interactive, inclusive and attractive
32	Smart America	To bring together research in Cyber-Physical Systems and to combine test-beds, projects and activities from different sectors, such as Smart Manufacturing, Healthcare, Smart Energy, Intelligent Transportation and Disaster Response, to show tangible and measurable benefits to the US economy and the daily lives of American citizens
33	Center for Urban Science + Progress (CUSP)	To use New York City as a laboratory and classroom to help cities around the world become more productive, livable, equitable, and resilient
34	Singapore-ETH Centre (SEC) - Future Cities Laboratory (Research program)	To strengthen the capacity of Singapore and Switzerland to research, understand and actively respond to the challenges of global environmental sustainability, motivated by an aspiration to realize the highest potential for present and future societies
35	Singapore-MIT Alliance for Research and Technology (SMART)	To focus on new paradigms for the planning, design and operation of future urban mobility systems
36	ICRI-Sustainable connected cities	To enhance the social, economic and environmental wellbeing of cities by advancing compute, communication and social constructs to deliver innovations in system architecture, algorithms and societal participation
37	Centre for Sustainable Development (CSD)	To design and develop sustainable practices for development activities, keeping the values of natural ecosystems and importance of their conservation through proper environmental planning and management

38	Centre for Sustainable Communications - ICT for sustainable cities (ICIT)	To develop new and interdisciplinary knowledge on how digital technology can support sustainable development in cities, to develop new knowledge regarding what digital solutions are relevant for making cities more environmentally sustainable, including both the urban infrastructures and citizens' everyday life, and to develop new knowledge regarding how these solutions can be successfully introduced and operated at both an individual and societal levels
39	Centre for IT-Intelligent Energy System in Cities - CITIES	To focus on individual aspects of energy systems, such as zero emissions buildings or intelligent power systems, and to provide valuable insight, that facilitates flexibility throughout the energy system
40	City Futures	To advance the understanding of Australia's cities, their people, the policies that manage their growth, and their impacts on the environment and economy
41	LSECities	To study how people and cities interact in a rapidly urbanizing world, focusing on how the design of cities impacts society, culture and the environment
42	Centre for Advanced Spatial Analysis (CASA)	To generate new knowledge and insights in city planning, policy and design, drawing on the latest geospatial methods and ideas in computer-based visualization and modelling
43	Future Cities Catapult	To bring together businesses, academics and city leaders to discuss and develop the cities of the future
44	Fraunhofer FCR - FOKUS	To consult about development of digital solutions in urban areas and about integration of systems and conceptualization of technical and organizational implementations
45	Centre de Recherche sur les Communautés Intelligentes (CERCI)	To conduct research in intelligent cities, focusing on citizens, on the city itself, and finally on the technology
46	Aristotle University of Thessaloniki - Urban and Regional Innovation Research	To enhance the ability of cities and regions to create environments supporting research and development, innovation, human skills and intelligence
47	Cisco's 'Smart + Connected Communities'	To help city leaders address city problems using intelligent networking capabilities, and to provide information and services to create more livable and thriving cities
48	IBM's 'Smarter Cities'	To offer Smart City solutions that can be built quickly, provide faster time to value, and lower costs and risks
49	Siemens Intelligent Infrastructure	To offer total integrated power solutions for safe, reliable and efficient power distribution; to provide smart grid technologies that can balance supply and demand, prevent power outages and integrate renewable power; to integrate mobility solutions that move people and goods faster, safer and with fewer resources; and to offer smart building technologies that drive energy efficiency, reduce costs, and protect and secure assets
50	Microsoft - CityNext	To apply the latest in cloud, big data, mobile, and social technologies and solutions for cities to overcome their challenges
51	Global Compact Cities Programme	To promote the adoption of the Global Compact's ten UN Principles by cities, and to provide a framework for translating the principles into day-to-day urban governance and management

A word cloud formed from the mandates of all 51 Smart City policy organizations listed in Table 14, after removing the words "cities", "smart" and "research" is shown in Figure 40, highlighting the words "urban", "solutions", "planning", "design", "development", etc.

Figure 40: State of Policy Quantitative Analysis, Aspect 2 – Policy Mandates

Another word cloud from the policy mandates, this time including 30 most frequent words selected from the total of 462 words and after grouping similar ones, is shown in Figure 41.

Figure 41: State of Policy Quantitative Analysis, Aspect 2 – Frequent Words

The 30 most frequent words can be classified into three categories (see Table 15): 1) Domain, i.e. the words related to research topics addressed by the organization; 2) Activities, i.e. words related to Smart City development; and 3) Organization, i.e. words describing the work of the organization. The first ten words in the Domain category highlight the theme of the organization – urban, city, innovation, sustainable, environment, systems, technologies, intelligent, communities and integrated; while the following eight words describe the sectoral focus of the organization – energy, future, infrastructure, policy, power, social, government and knowledge. The six words listed in the Activities Domain describe Smart City processes which the organization supports, i.e. development, design, planning and management; and the types of activities that the organization conducts, i.e. provide and promote. Finally, the words in the Organization Domain refer to the internal activities of the organization and their focus, i.e. center, solutions, areas, institute, projects and works.

Table 15: State of Policy Quantitative Analysis, Aspect 2 – Most Frequent Words					
DOMAIN			ACTIVITIES		
NO	WORD	COUNT	NO	WORD	COUNT
1	Urban	18	19	Development	20
2	City	17	20	Design	11
3	Innovation	17	21	Planning	10
4	Sustainable	13	22	Provide	9
5	Environment	12	23	Management	9
6	Systems	12	24	Promote	5
7	Technologies	10	ORGANIZATION		
8	Intelligent	9	NO	WORD	COUNT
9	Communities	8	25	Center	14
10	Integrated	7	26	Solutions	14
11	Energy	6	27	Areas	6
12	Future	6	28	Institute	6
13	Infrastructure	6	29	Projects	6
14	Policy	6	30	Work	6
15	Power	6			
16	Social	6			
17	Government	5			
18	Knowledge	5			

5.2.3. Aspect 3 – Policy Focus

Using six policy dimensions of the well-known Smart City model (Giffinger et al. 2010): Economy, Governance, Mobility, Environment, Living and People, and based on the websites of the selected 51 Smart City policy organizations, we analyze the organizations' policy focus. The findings, depicted in Table 16, shows that 34 organizations (67%) focus on Living, 30 (59%) on Mobility, 30 (59%) on Environment, 29 (57%) on People, 28 (55%) on Economy and 28 (55%) on Governance. An organization focuses on 3.5 dimensions on average but only 14 (27%) address all six dimensions.

Table 16: State of Policy Quantitative Analysis, Aspect 3 – Policy Focus								
NO	INSTITUTIONS	ECONOMY	GOVERNANCE	MOBILITY	ENVIRONMENT	LIVING	PEOPLE	DOMAINS
1	Reinvent Cities	x	x	x	x	x	x	6
2	Smart Growth America	x	x	x	x	x	x	6
3	The World Bank	x	x	x	x	x	x	6
4	World Cities Network	x	x					2
5	Urban Institute	x						1

6	Sustainable Cities Collective	x	x	x	x	x	x	6
7	Intelligent Community Forum (ICF)	x						1
8	Center for Smart City Innovation	x						1
9	Smart Cities Research Center			x		x	x	3
10	MIT City Science			x		x	x	3
11	Center for Information & System Engineering	x			x			2
12	Sustainable Smart Cities Research Center			x	x	x		3
13	Columbia University - Center for Smart Cities			x	x	x		3
14	Centre for IT-Intelligent Energy Systems in cities (Cities)				x			1
15	Universitat Politècnica de Catalunya (UPC) - Smart Cities	x	x	x	x	x	x	6
16	Trinity Centre for Smart and Sustainable Cities			x	x	x	x	4
17	Smart City Institute	x	x	x	x	x	x	6
18	German Center for Research and Innovation			x	x	x	x	4
19	Digital Economy Lab	x						1
20	INTELI Inteligência em Inovação - Centro de Inovação	x	x	x	x	x	x	6
21	Amsterdam Smart City (ASC)	x		x		x		3
22	Smart Cities Council	x		x	x			3
23	Center for Innovation in Cities		x					1
24	Algoritmi Center- Sustainable and Smart Cities (SSC)	x	x	x	x	x	x	6
25	ASH Center for Democratic Governance and Innovation		x					1
26	Fraunhofer FOKUS		x	x	x	x		4
27	Institute for the Future (IFTF)	x	x	x	x	x	x	6
28	TerraSwarm Research Center					x	x	2
29	Smart City Innovation Centre	x	x	x	x	x	x	6
30	Hitachi Data Systems	x	x	x	x	x	x	6
31	SmartCityStudio	x	x	x	x	x	x	6
32	Smart America	x	x	x	x	x	x	6
33	Center for Urban Science + Progress (CUSP)			x	x	x	x	4
34	Singapore-ETH Centre (SEC) - Future Cities Laboratory	x	x	x	x	x	x	6
35	Singapore-MIT Alliance for Research and Technology		x	x	x			3
36	ICRI-Sustainable Connected Cities	x				x	x	3
37	Centre for sustainable development (CSD)		x		x	x	x	4
38	Centre for Sustainable Communications – ICIT				x	x		2
39	Centre for IT-Intelligent Energy System in Cities - CITIES				x			1
40	City Futures	x		x	x	x	x	5
41	LSECities	x			x		x	3
42	Centre for Advanced Spatial Analysis (CASA)		x	x				2
43	Future Cities Catapult	x	x			x	x	4
44	Fraunhofer FCR - FOKUS		x					1

45	Centre de Recherche sur les Communautés Intelligente		x				x	2
46	Aristotle University of Thessaloniki – URENIO		x			x		2
47	Cisco's 'Smart + Connected Communities'		x	x		x		3
48	IBM's 'Smarter Cities'		x	x		x	x	4
49	Siemens Intelligent Infrastructure			x		x		2
50	Microsoft - CityNext	x	x			x	x	4
51	Global Compact Cities Programme	x			x		x	3
Total number of Institutions per Area		28	28	30	30	34	29	179

Figure 42 depicts the percentages of organizations covering different Smart City dimensions. Although all six dimensions receive attention from similar numbers of organizations, three dimensions receive slightly more attention than others, i.e. Living (67%), Environment (59%) and People (57%). This preference is aligned with the Smart City citizen-driven approach discussed in (Mulder 2014).

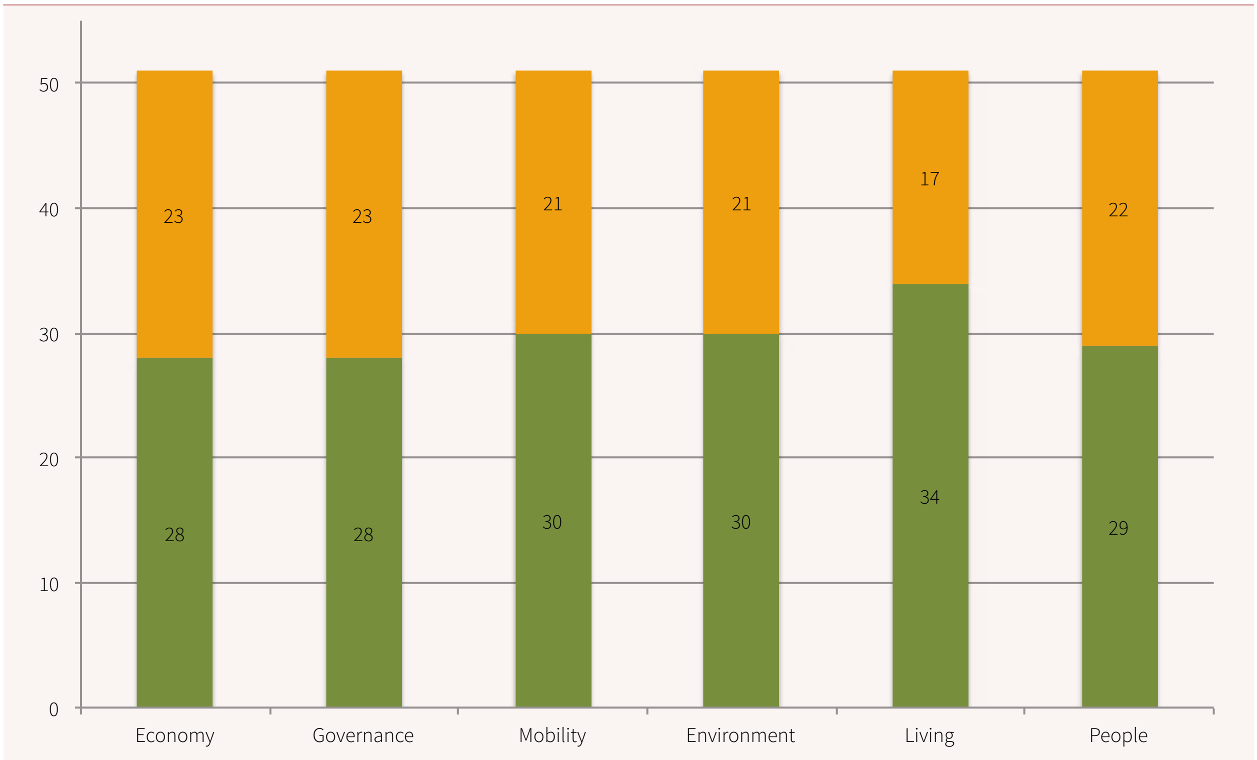

Figure 42: State of Policy Quantitative Analysis, Aspect 3 – Dimensions

5.3. Qualitative Analysis

This section analyzes the content of various Smart City-related policy documents. The analysis applies the framework of 13 Smart City attributes derived from the project's terms of reference and further study, with the findings described in the following sections:

1. Values – Section 5.3.1;
2. Drivers – Section 5.3.2;
3. Challenges – Section 5.3.3;
4. Risks – Section 5.3.4;

5. Regions – Section 5.3.5;
6. Technologies – Section 5.3.6;
7. Tools – Section 5.3.7;
8. Approaches – Section 5.3.8;
9. Stakeholders – Section 5.3.9;
10. Governance – Section 5.3.10;
11. Maturity models – Section 5.3.11;
12. Innovations – Section 5.3.12; and
13. Benefits – Section 5.3.13.

The analyzed documents were produced by the Smart City policy organizations including but not limited to the organizations identified and analyzed in Section 5.2.

5.3.1. Attribute 1 – Values

The Values Attribute captures what urban citizens and other city stakeholders expect to achieve from Smart City initiatives, i.e. what needs are important to them and what are acceptable ways of fulfilling such needs through Smart City initiatives. The Values Attribute is part of the Smart City context and is likely to change together with this context. A number of policy papers further elaborate and in some cases provides concrete values to the Values Attribute. These policy inputs are described below.

ITU proposed a value framework to guide Smart City initiatives using four dimensions: 1) economy – "The city must be able to thrive – jobs, growth, finance"; 2) governance – "The city must be robust in its ability in administrating policies and pulling together the different elements"; 3) environment – "The city must be sustainable in its functioning for future generations" and 4) society – the city is for its inhabitants (the citizens)" (ITU 2014a). ITU also highlights that in traditional approaches to urban development, all infrastructure systems are managed in silos, with little communication and information sharing among and across government agencies and the civil society. Therefore, it recommends to adopt a holistic approach to create multiple infrastructures, strengthen the motivation for government participation, apply technologies, and integrate various smart infrastructure management systems, all combined with citizen collaboration (ITU 2014a).

The UK Government recommends that city authorities be open to learning from and with others, to experiment with different approaches and business models, and to demonstrate urban performance through citizen dashboards (UK Department for Business Innovation & Skills 2013). The Indian Government also recommends that making city performance information available to citizens will create a strong incentive to improving such performance, and that involving citizens in city activities and informing them about the efforts and the reasons for such initiatives will help overcome resistance to change, facilitate civic discipline and help carry out activities (Sridhar and Sridhar 2011).

5.3.2. Attribute 2 – Drivers

The Drivers Attribute represents the factors that motivate, provide an impulse and enable the establishment and implementation of Smart City initiatives. Like the Values Attribute, Drivers are part of the Smart City context and are likely to change together with this context. A number of policy papers provide characterization, describe approaches, and in some cases provide concrete values to this attribute. These policy inputs are described below.

ITU advocates that economy, governance, environment and people are four main drivers of Smart City initiatives (ITU 2014a), it highlights that a Smart Sustainable City has sustainable urban development through the use of digital technology without degrading the quality of life of urban citizens as its end goal.

IBM highlights the economy as the main driver due to large scale investments, business networks and innovation-friendly environment (Dirks, Gurdgiev, and Keeling 2010). Sustainable city development to benefit citizens, the economy and the environment is another driver (Schaefer 2011). CISCO advocates that the most significant drivers for a Smart City is city infrastructure including energy, mobility, water, waste management and other systems, and the main reasons for Smart City development are: deteriorating city infrastructures, global business and economic development, charging fees, strengthening financial stability and improving job conditions (You and Learn 2014). The CityNext initiative emphasizes safety, education and health drivers (Microsoft 2014).

According to the UK Government, the main urban drivers are making cities more liveable and resilient, and able to respond quickly to changes in their environment (UK Department for Business Innovation & Skills 2013) while the Scottish Government promotes the vision of becoming a world leading digital nation (The Scottish Government et al. 2015). Finally, the Government of India formulated a number of Smart City drivers: 1) attracting investment and talent; 2) improving competitiveness to create jobs; 3) providing social, environmental and financial sustainability; and 4) improving quality of life including safety, security, inclusiveness, entertainment, public services, healthcare, education, transparency, accountability and governance participation (Government of India 2014).

5.3.3. Attribute 3 – Challenges

The Challenges Attribute represents the barriers and obstacles related to the establishment and implementation of Smart City initiatives, due to the social, economic, political, etc. environment. Like Values and Drivers, Challenges is part of the Smart City context and is likely to change together with this context. A number of policy papers elaborate and in some cases provides concrete values to this attribute. These policy inputs are described below.

Concerning social challenges, the fast growth of cities will give rise to significant inequalities in productivity and income inside and across cities, and between rural and urban cities (Commission On Growth And Development et al. 2009). As a result, policymakers will face political and ethnical tensions which must be balanced with economic benefits. The tensions and difficulties in achieving efficient urban development, which entails some kind of equilibrium between wage, cost of living and labor supply, lead developing countries to resist fast urbanization, viewing it as unmanageable pathology. According to (ISO 2013a), cities must provide quality of life to their citizens, while simultaneously dealing with the pressures of population growth, urbanization and climate change.

Concerning environmental challenges, generation of waste is rapidly increasing in quantity and complexity along with the urbanization growth – the solid waste will reach a peak in 2100, and collecting and disposing such waste will have a tremendous impact on municipal budgets (Commission On Growth And Development et al. 2009). According to the World Bank (The World Bank 2013), the carbon emissions due to urban transport will increase exponentially as demands for private transportation in developing countries will grow. New transport policies to provide viable alternatives to automobile transport are required, as is the need for cities to reduce carbon emissions. Cimate change adaptation and resilience, however, are not yet integrated in urban planning. Local government efforts towards policies to mitigate climate change and strengthen climate action are critical. According to (ITU 2014a), urbanization adds pressure on resources and increases consumption of energy, water, sanitation, public services, education and healthcare. As social, economic and environment dimensions are interconnected, urbanization will contribute to environmental degradation on the local, regional and global scales – cities are responsible for 70% of the global gas emissions and 60%-80% of the energy consumption.

Concerning financial, organizational and technological challenges, according to CISCO (You and Learn 2014), funding is by far the biggest challenge of cities and the officials need to find the right financial mechanisms for short- and long-term Smart City projects. Internal organization challenges such as the lack of cross-departmental coordination alignment are also highlighted. The European Commission's "Citizen Science and Smart Cities Report" emphasizes the challenge of integrating all quantitative and qualitative data from heterogeneous sources including Citizen Science and Smart City projects and connecting them with analytical models as currently "there is little interoperability and reusability of the data, apps, and services developed in each project" and given "ephemeral nature of much of the data, which disappear short after the end of the projects" (Craglia and Eds 2014). A city is smart if it makes an optimal use of interconnected information to optimize the use of limited resources (Dirks et al. 2010).

Concerning cross-sectoral issues, according to IBM (Schaefer 2011), policies to overcome city challenges include: 1) reducing transport congestion; 2) improving safety by reducing crime rates and response time; 3) improving public services, education and training; 4) enhancing the provision of healthcare; 5) reducing capital and operational expenses; 6) increasing the use of digital technology and 7) ensuring security and resilience across systems. According to the UK Government (UK Department for Business Innovation & Skills 2013), some policy recommendations to address city challenges include: 1) restructuring the economy – economic growth and resilience are the main priorities for city authorities; 2) growing city infrastructure in integrated ways to sustain urban population growth and its pressure on transport systems and housing; 3) improving energy efficiency and reducing carbon emissions while assuring acceptable security and price levels; 4) supporting the shift toward online service provision, shopping and entertainment; 5) supporting the needs of the aging population and how such needs are fulfilled on the city levels; and 6) providing cities with more flexibility to charging local fees and business rates, in addition to receiving government grants to be able to respond to challenges.

5.3.4. Attribute 4 – Risks

The Risks Attribute represents possible occurrence of undesirable and potentially damaging consequences of Smart City initiatives and how such consequences could be avoided, minimized or managed. Like Values, Drivers and Challenges, the Risks Attribute is part of the Smart City context and is likely to change together with this context. A number of policy papers further and provide values to this attribute. These policy inputs are described below.

According to the Commission on Growth and Development (Commission On Growth And Development et al. 2009), the market failures due to inefficient production, transit congestion and overcrowded places is a major risk which should be addressed through technological, institutional and policy changes. Regardless of their development levels, cities are vulnerable to disasters because of concentrated populations and they need disaster management to deal with the risk and impact of natural disasters (ITU 2014a). The World Bank highlights severe impact of climate change on coastal cities (The World Bank 2013). CISCO points out that the top risk to Smart City development is funding and cities should be aware of existing funding mechanisms and find innovative funding mechanisms (You and Learn 2014). The UK Government identified a set of risks to Smart City public service delivery: information and coordination failure; lack of proactive approach; inclusivity of public service delivery; fear of change and lack of trust in data privacy and system integrity; and proposed an integrated way to address them (UK Department for Business Innovation & Skills 2013).

5.3.5. Attribute 5 – Regions

The Regions Attribute represents how a city's Smart City initiatives are informed by its history and unique path to development, and how they could be benchmarked against other cities in the region. Like Values, Drivers, Challenges and Risks, the Regions Attribute is part of the Smart City context and likely to change together with it. A number of policy papers elaborate and provide values to this attribute. These policy inputs are described below.

According to (Commission On Growth And Development et al. 2009), while the economic development of cities depend on some global facts that affect all countries/cities, each country/city has its own geography, institutions, political conditions and local economic conditions that determine the set of policies that should be defined for solving problems and promoting productivity and prosperity. With globalization, some cities experience rapid growth and others are left behind, which highlights the importance of geography such as resource endowments and proximity to rivers and ports, the role of the density of human interactions for economic development and growth in regions, and threshold effects, i.e. avoiding the largest city in a country becoming too large relative to the others and absorbing all economic growth. However, smaller cities present considerable heterogeneous capabilities, so local policies should be aligned with national agendas. Taking advantage of geography and human density may increase city productivity.

According to the European Policy Department (Manville et al. 2014) and its analysis of EU's Smart City initiatives and to what extent they are aligned with city development goals, innovation plans, and Europe 2020 targets, the most common Smart City initiatives are associated with smart environment at 33% and smart mobility at 21%, while the initiatives related to economy, governance, living and people represent only 10% of the Smart City initiatives. The analysis highlights that, in general, Smart City initiatives are aligned with city development goals, innovation plans and the overarching Europe 2020 targets. However, characteristics of such initiatives reflect the actual situation of the city or country, while the European strategy serves to only stimulate local and national actions. Each Smart City initiative has its unique flavor, and involves the participation of local, regional or national governments, the private sector and society, albeit with different weights and influences.

5.3.6. Attribute 6 – Technologies

The Technologies Attribute represent the presence of disruptive digital technologies, how they can generate public value, and what is required to apply them in the Smart City context. Unlike previous attributes, the Technologies Attribute is not part of the Smart City context, but an input to Smart City transformation. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

According to ITU (ITU 2014a), the technology potential in Smart City initiatives? is reflected in three main city dimensions: 1) environment and sustainability; 2) city-level services; and 3) quality of life. The basic city infrastructure will be equipped with advanced technologies including: smart energy, smart buildings, smart transportation, smart water, smart waste, smart physical safety and security, smart health care, and smart education. Some examples of technology uses include: generating information and knowledge sharing, forecasting behaviors and integrating systems, with data prediction, analytics, big data, open data, Internet of Things, data accessibility and management, data security, mobile broadband, ubiquitous sensor networks, all becoming integrated parts of the Smart City infrastructure.

The role played by digital technology in city sustainability is crucial due to aggregation and sharing of information and knowledge on digital platforms, allowing to better understand how city functions in terms of consumption, services and social behavior, and allowing to define policies aimed at improving the quality of urban life. The digital infrastructure is the center of a Smart City, orchestrating interactions and integrating all systems together.

According to IBM, Smart City technology should be used for: 1) collecting and managing information, 2) aggregating and analyzing data and 3) advancing analysis to optimize system behaviors (Dirks et al. 2010). In turn, CISCO recommends as the top five Smart City technologies: communication networks; intelligent infrastructures; computation, data storage and data centers; data analysis; and cyber security (You and Learn 2014). The UK Government recommends building intelligent infrastructure equipped with smart systems and Internet of Things, to enable data access to service providers to manage service delivery and inform about strategic investment needs, for instance, if the city transport is prepared to cope with peak hours demands (UK Department for Business Innovation & Skills 2013). The Government of India recommends the use of clean technologies that use renewable materials and energy to reduce environmental footprint (Government of India 2014).

5.3.7. Attribute 7 – Tools

The Tools Attribute represents various conceptual, technical and methodological guides and instruments, many available on digital platforms, to support planning and implementation of Smart City initiatives. Like the Technologies Attribute, the Tools Attribute is an input to Smart City transformation. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

ITU recommends two Smart City tools: ITU-T “Key Performance Indicators in Smart Sustainable Cities” to measure Smart City performance (ITU 2014b) and SSC “A Smart Sustainable City” (ITU 2014a). UN-Habitat recommends the use of the “City Prosperity Index” to measure economic growth (UN-HABITAT 2013). ISO recommends the use of two Smart City standards: “ISO 37120 – Sustainable Development of Communities – Indicators for City Services and Quality of Life” and “ISO 37101 - Sustainable Development of Communities – Management Systems – Requirements with Guidance for Resilience and Smartness” (ISO 2014) to help develop more efficient, safe, sustainable and reliable Smart Cities (ISO 2013b). IBM recommends the use of four Smart City tools: Smart City Assessment, Smarter City Maturity Model, Smarter City Actionable Business Architecture and Municipal Reference Model (Schaefer 2011). Microsoft recommends the CityNext Assessment and TrusteGov tools to measure the readiness of a city (Microsoft 2014). The Government of India recommends three Smart City tools: Citizen Reference Framework, Smart City Development Plan and Environmental Sustainability Plan (Government of India 2014).

The European Policy Department (Manville et al. 2014) analyzes six dimensions addressed by Smart City initiatives pursued by European cities: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. For each dimension, the implementation should include policies, norms and standards; the study shows that none of the investigated initiatives successfully addressed the six dimensions, e.g. the very successful Amsterdam Smart City initiative addressed almost 3.5 dimensions.

According to (Whyte 2014), the Ministry of Industry and Information Technology (MIIT), National Development and Reform Commission (NDRC), the Ministry of Housing and Urban-Rural Development (MOHURD) and other departments of the Central Government in China introduced relevant regulations to standardize Smart City development in China. Since 2011, MIIT created a number of Smart City implementation programs, such as the 12th Five-year Plan for the Development of Information Security Industry, the 12th Five-year Plan for the Development of Internet of Things and the 12th Five-year Plan for the Development of e-Commerce. Another initiative by NDRC, MIIT, the Ministry of Science and Technology, the Ministry of Public Security, the Ministry of

Finance, the Ministry of Land and Resources (MOHURD) and the Ministry of Transport developed a document "Guiding Opinions on Promoting the Healthy Development of Smart Cities", and MOHURD released in 2012 a new measurement tool for the administration of National Smart Cities and the Pilot Index System for National Smart Cities (District and Towns) and started its application to pilot cities.

5.3.8. Attribute 8 – Approaches

The Approaches Attribute represents the fundamental decisions, supported by practical, methodological or even philosophical arguments, concerning how Smart City transformation will be planned and conducted. Unlike Technologies and Tools, the Approaches Attribute is not part of inputs to Smart City transformation, but part of the transformation itself. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

Concerning top-down approaches, according to the World Bank (Commission On Growth And Development et al. 2009) (The World Bank 2013), the investments in infrastructure will be locked in the next years and therefore cities, particularly in developing countries in fast urbanization rates must as soon as possible adopt sustainable development policies. The UK Government (UK Department for Business Innovation & Skills 2013) recommends another top-down approach to supporting Smart City development through integrated solutions, national digital platform for businesses, and citizen centric public service delivery. Yet another top-down approach is by the European Policy Department (Manville et al. 2014) which recommends that public authorities apply assessment frameworks to measure Smart City solutions; that Smart City strategies should be explicit, specific, measurable, achievable, realistic, time-dependent and aligned with the Europe 2020 targets; and that Smart City solutions include: 1) smart cycling plans, 2) integrated multi-modal transport, 3) smart traffic flow system, 4) Smart City lighting, 5) smart building technology and management, 6) smart open services platforms, 7) single access points for government services and 8) local integrated sustainability initiatives.

A bottom-up approach for the EU, according to (CASI 2014), includes the following most relevant Smart City policy actions: 1) local authorities need specialized knowledge to define sound and efficient strategies and action plans; 2) local authorities need reliable information for assessing the achievement of local, national and regional (EU) targets in energy, governance, citizenship, culture and other areas; 3) the needs and opinions of citizens, companies, research community and other stakeholders should be considered for defining pertinent strategies; 4) two crucial features for stakeholder participation are enhanced public engagement and interdisciplinary cooperation of social actors; 5) experimentation with new solutions and innovations in specific urban conditions is encouraged for replication and deployment of solutions in different cities; and 6) sound communication of best practices and successful Smart City measures are needed for experience sharing. Another bottom-up approach, by IBM, is to prioritize investments in core systems such as transport, government services and education, public safety, public health, energy, environmental sustainability and urban planning (Dirks et al. 2010).

According to (Whyte 2014) which includes a study of Smart City trends and policies and a review of Chinese and European Smart City projects: 1) the concept of Smart City is implemented differently by different cities, from individual traffic solutions, through waste management solutions, to integrated city-wide services; 2) there is no single set of recommendations on how to "get smarter" for any city; 3) it is possible to offer a set of principles applicable to any city; 4) becoming a Smart City is a process with no definite end state; and 5) defining a roadmap for continuous step-by-step improvements is possible. These recommendations can be both applied top-down and bottom-up.

5.3.9. Attribute 9 – Stakeholders

The Stakeholders Attribute represents all parties, including public, private and voluntary sectors with interest and concern in Smart City initiatives and their progress and outcomes. Like the Approaches Attribute, the Stakeholders Attribute is part of the Smart City transformation. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

The World Bank highlights the complexity of the city metabolism and interactions between government, citizens, businesses and other actors, and recommends the promotion of cooperative Smart City networks to achieve sustainable futures with private and public sectors contributing to sustainable policies and incentives to guide private activities, generate innovation and share information (The World Bank 2013). To ensure urban resilience, multi-sectoral partnerships involving public, private and community participation are needed. While public-private partnerships increase the provision of new public services, policies and regulations that protect the interests of citizens and investors must be created.

The Indian Government advocates public-private partnerships to transfer innovation and efficiency from the private to the public sectors. The involvement of the private sector in public services delivery enables higher resource optimization (Government of India 2014).

5.3.10. Attribute 10 – Governance

The Governance Attribute represents how the Smart City government operates, how it manages public funds, how it delivers public infrastructure and services, how it supports sustainable city development, and how it engages its citizens in decision-making processes. Like the Approaches and Stakeholders Attributes, the Governance Attribute is part of Smart City transformation. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

According to (Commission On Growth And Development et al. 2009): 1) when financial and technical capacity is scarce, governments should prioritize infrastructure investments and service improvement; 2) differences between national and local governments slow down the transformation of local governance structures and policies to best suit city growth; 3) urban transformation requires politics, social norms, institutional changes and strong financial systems; 4) while central governments should ensure labor mobility and internal trade and better infrastructure, local governments should focus on quality of life; the tensions between central and local government objectives include labor promotion and job creation; and 5) in developing countries, urban policies generally aim at improving public infrastructure and limiting the flow of people from rural areas to crowded cities.

According to the World Bank, the solution to Smart City governance lies in institutions and their interactions, and citizens are emerging as a crucial stakeholder in the governance of Smart Cities (The World Bank 2013). Specific governance policy recommendations include: 1) stimulate continuous improvements in accountability, transparency and good governance; 2) develop policies to increase energy efficiency and promote renewable energy for buildings and transport; 3) encourage the creation of compact and efficient cities through regulations and incentives; 4) build strong partnerships between public and private sectors and the society to address multi-sectoral policies for sustainable development; 5) build capacity in local governments and enable national-level policies to achieve sustainable cities; 6) build transnational municipal networks to allow global city-to-city collaborations to develop innovative approaches; and 7) ideas, tools, metrics, etc. to build sustainable cities do not themselves create such cities.

The UK Government promotes five kinds of Smart City policies: 1) encourage and empower city authorities to develop a city vision and grow leadership to provide solutions to city problems; 2) promote, give access to and share open data and develop open data standards; 3) execute programs to develop Smart City technologies and demonstrate their efficiency; 4) execute departmental programs to encourage the use of new approaches and technologies, and transform both services delivered and costumer behavior; and 5) participate in EU funding programs (UK Department for Business Innovation & Skills 2013).

According to (Microsoft 2014), Smart City policies recommendations include: 1) identifying mayor perceptions, i.e. political agenda and project alignment; 2) self-diagnosis, i.e. evaluating government situation, share the vision, and implement management systems; 3) action plans, i.e. plan and execute local government programs and assess their performance; and 4) government plans, i.e. revise action plans based on performance, propose and build a digital agenda, and align political plans with citizen needs.

According to the Indian Government (Government of India 2014): 1) apply a governance approach based on incentives rather than enforcement; 2) broke down the work into silos with institutional integration; and 3) enable citizen participation in governance processes through by making government information available online and using social media.

5.3.11. Attribute 11 – Maturity Models

The Maturity Models Attribute represents the advancement of Smart City development along a series of discrete maturity stages, the achievement of higher stages representing a significant advancement compared to the lower stages. Like the Approaches, Stakeholders and Governance Attributes, the Maturity Models Attribute is part of Smart City transformation. A number of policy papers further elaborate and provide concrete values to this attribute. These policy inputs are described below.

According to ITU (ITU 2014a), determining Smart City maturity requires defining various smartness and sustainability attributes to be part of Smart City metrics and references points. According to the World Bank (The World Bank 2013), maturity should examine urban metabolism, i.e. patterns of production and consumption, rather than traditional ecological footprint. Such analysis, although it needs many assumptions, captures economic growth, urbanization pace and gas emissions. While all cities should measure city operations, environment and social data, standardized data is needed to compare cities. In addition to maturity, cities should also measure resilience. According to IBM (Schaefer 2011), Smart City maturity should be measured in terms of improvements in quality of life and economic growth through the use of digital technologies.

The ISO standard "ISO 37120 – Sustainable Development of Communities – Indicators for City Services and Quality of Life" provides an assessment tool to measure the sustainability of Smart City projects, including targets and benchmarks to assist policymakers and city managers in their activities, and a set of indicators to measure city performance in different areas: economy, e.g. youth unemployment rate; education, e.g. percentage of female school-aged population enrolled in schools; energy, e.g. energy consumption of public buildings per year; environment, e.g. greenhouse gas emissions measured in tons per capita; finance, e.g. tax collected as a percentage of tax billed; fire and emergency response, e.g. number of firefighters per 100,000 population; governance, e.g. voter participation in the last municipal election; health, e.g. average life expectancy; recreation, e.g. square meters of public indoor recreation space per capita; safety, e.g. crimes against property per 100,000 population; shelter, e.g. percentage of city population living in slums; solid waste, e.g. percentage of the city's solid waste that is recycled; telecommunication and innovation, e.g. number of Internet connections per 100,000 population; transportation, e.g. kilometers of high capacity public transport system per 100,000 population; urban planning, e.g. green areas in hectares per 100,000 population; wastewater, e.g. percentage of city population served by wastewater collection; and water and sanitation, e.g. total domestic water consumption per capita.

According to (Whyte 2014), the "Smart City Staircase Roadmap towards Maturity" includes five maturity levels: 1) not yet addressed; 2) basic; 3) average; 4) more advanced; and 5) state-of-the art. The roadmap is based on two principles: 1) no leapfrogging – due to managerial, technological and financial capacity and excessive pressure on many city systems and functions putting normal day-to-day operations at risk, it is not possible to advance more than one step at a time; and 2) no isolated advances – it is counter-productive to advance one characteristic while neglecting others although not all characteristics must have the same level of maturity and the stakeholders should define and agree on priority areas. The roadmap identifies eight areas including features to be achieved at each stage and some policy recommendations: 1) strategy – ensuring integrated city planning, looking beyond the horizon and using modern management tools; 2) stakeholders – pursuing active customer engagement and seeking feedback and opinions from employees; 3) governance – aligning organizational structure with Smart City vision, and promoting public participation; 4) funding – developing sustainable funding plans using scenario planning; 5) value assessment – applying rational planning and analysis tools and utilizing private sector know-how; 6) business models – allowing for creativity and clearly defining business model parameters; 7) technology infrastructure – defining technology-neutral infrastructure targets, defining strategic focus, using open standards and open data, and defining a policy framework to facilitate modernization; and 8) services – prioritizing services, creating service platforms, and collaborating with other cities.

5.3.12. Attribute 12 – Innovations

The Innovations Attribute represents the capacity of a Smart City for creating and realizing new ideas, processes, services, etc. around the use of digital technologies to address existing needs or utilize new opportunities and create an impact on the city. Unlike the Approaches, Stakeholders, Governance and Maturity Models that belong to Smart City transformation, the Innovations Attribute belongs to Smart City outcomes. A number of policy papers elaborate and provide concrete values to this attribute. These policy inputs are described below.

According to ITU (ITU 2014a), digital technology and tools can provide innovative, eco-friendly and economically viable solutions for Smart Cities. The innovations could be advanced, e.g. in the form of efficient water management based on real-time information exchange through sensors, public transport systems relying on GPS information, environmental solutions based on quality of air and electromagnetic field measurement, etc.

The UK Government (UK Department for Business Innovation & Skills 2013) recommends that its cities adapt their strategies to the current city challenges and to innovate in the service delivery, in particular by: 1) resorting to service outsourcing; 2) integrating services both at the back office and at the front office; 3) online service delivery; and 4) access to open data to enable the development of new services and citizens be informed about city operations.

According to IBM (Dirks et al. 2010), the economic growth and city competitiveness depend deeply on the skills of citizens and innovative capacity of the city economy. Bases on that, IBM recommends the policies for: 1) attracting international talent with quality of life within the city; 2) developing local talent through education and training; 3) investing in education infrastructures; 4) enhancing and deploying citizen skills based on demand and changes in the labor force; and 5) trying to maintain the local talent to avoid brain drain. IBM also recognizes the importance of identifying the strengths of a city to attract skills, knowledge and creativity, and Smart City strategies to take advantage of these strengths.

5.3.13. Attribute 13 – Benefits

The Benefits Attribute represents a range of positive outcomes obtained by the city and its various stakeholders due to its transformation into a Smart City. Like the Innovations Attribute, the Benefits Attribute belongs to Smart City outcomes. A number of policy papers elaborate and provide values to this attribute. These policy inputs are described below.

According to (ITU 2014a), transforming cities with digital technologies allows more efficient management of resources and infrastructures, green environment, smart governance and higher quality of life for citizens. Furthermore, an innovative Smart City not only improves quality of life, but optimizes city operations, services and competitiveness, while ensuring the economic, social and environmental sustainability. According to (The World Bank 2013), a resilient Smart City has the capacity to adapt and reorganize itself in response to external shocks, and continue to function. Indeed, changes in resilient cities caused by external shocks can create opportunities for innovation. According to the European Commission (Craglia and Eds 2014), Smart Cities offer the best quality of life and the lowest use of resources.

IBM highlights that investments in Smarter City's infrastructure result in cost savings and increase the efficiency of city operations, putting the city in a good position for long-term economic growth (Dirks et al. 2010). According to CISCO, municipalities worldwide are trying to improve their infrastructure and be more attractive to businesses and investors through Smart City initiatives (You and Learn 2014). According (Microsoft 2014), Smart City initiatives bring benefits including: 1) reducing error margins, enhancing cooperation and speeding up service delivery; 2) engaging citizens through mobile and social applications; and 3) accelerating access to safe digital solutions, e.g. the cloud, and faster response times.

The UK Government argues that a Smart City brings together infrastructure, human capital, communities, institutions and technologies to create sustainable economic development and a better environment for citizens (UK Department for Business Innovation & Skills 2013). According to (Government of India 2014), a Smart City should offer: high quality of life, e.g. affordable housing; efficient social and institutional infrastructure; quality water supply; clean air; quality education; cost-efficient healthcare; security; entertainment; sports; robust high speed connectivity; and fast and efficient urban mobility; while reducing the need for travel through online services, thus reducing congestion, pollutants and energy use.

6. Case Study Development

Complementing research and policy literature reviews in Sections 4 and 5 of this report, this section focuses on the development of 21 real-life case studies of Smart Cities for Sustainable Development, selected among 119 relevant initiatives from around the world. The section starts with data collection process in Section 6.1, followed by the quantitative analysis of the 119 initiatives in Section 6.2, followed by the qualitative analysis of 21 fully developed case studies in Section 6.3. The quantitative analysis is based upon 7 case study-specific aspects different from those applied in the quantitative analysis conducted in Sections 4 and 5, while the qualitative analysis is based upon the same 13 attributes as applied in Sections 4 and 5, derived from the project's terms of reference and further studies.

6.1. Data Collection

The aim of the data collection process was to identify relevant initiatives to assess the state of practice in Smart Cities for Sustainable Development and identify possible case studies. The data process was divided into three steps: 1) Identifying Smart City for Sustainable Development initiatives from around the world and creating a repository of examples to capture the state of practice in the area; 2) Selecting initiatives from the repository and documenting them as case studies; and 3) Selecting relevant case studies and interviewing expert involved with them to gain access to first-hand knowledge and experience.

The following sections explain each step of this process, including Smart City initiatives in Section 6.1.1, the development of such initiatives into case studies in Section 6.1.2 and the organization of interviews concerning selected case studies in Section 6.1.3.

6.1.1. Smart City Initiatives

Three data sources were used to identify Smart City initiatives: 1) the case studies identified through the research literature review conducted in Section 4; 2) the case studies developed by Smart City policy organizations identified in Section 5; and 3) the case studies known to the researchers conducting this work.

In total, 119 Smart City initiatives were identified from these sources, included in the repository and analyzed quantitatively: 46 were identified through the research literature review; 61 through Smart City policy organizations; and 12 were known to the researchers. All 119 initiatives are listed in Appendix C.1 of this report, and the results of quantitative analysis of these initiatives are presented in Section 6.2.

6.1.2. Case Studies

The case studies were selected among the 119 identified Smart City initiatives based on the following criteria: 1) relevance to developing countries – given the focus of the study, the researchers decide that at least 80% of the case studies should be from developing countries; 2) richness of information – a Smart City initiative should be documented with enough detailed information to be selected as a case study; and 3) balanced geographical distribution – the case studies should be selected from various regions in the world.

To gather all possible information related to a case study, a template document was created. The entire Template is included in Appendix C.2, and its structure is described as follows:

1. *Identifier* – This section includes information about the identifier of the case study, the name of the initiative and the country where it was developed. It also contains information about the structure of the whole template.
2. *Sources* – This section provides information about: 1) the initiative described – name and case; 2) the survey – the major sources of information used to carry out the survey including URLs, descriptions, highlights and comments; and 3) the surveyor – who carried out the survey, who revised the result and when these actions were done.
3. *Who* – This section includes information about the institution and its partners responsible for conducting the initiative. For each institution, the template includes: 1) its name; 2) whether the institutions is a founder of the initiative; 3) the role played by the institution in the initiative, such as developer, planner, implementer of technology infrastructure and others; and 4) the sector where the institution belongs such as government, industry, academia, non-government, etc.
4. *Where and when* – This section includes information about the location, i.e. the country, province, city and region where the initiative was conducted, and when.
5. *What* – This section includes information about the initiative itself: 1) the background information about the city where the initiative was conducted; 2) the main concepts underpinning the initiative, such as digital city, intelligent city, knowledge city, eco city, ubiquitous city or smart city; 3) the aim of the initiative; 4) the main innovations brought in by the initiative; 5) the lessons learnt; and 6) any other information.
6. *Why* – This section includes the rationale for the initiative, and which dimensions it contributes to: 1) economic development; 2) governance development; 3) mobility; 4) environment; 5) social development including social and human capital; and 6) quality of life. It also collects data about the benefits and values promoted by the initiative.
7. *Implementation* – This section documents how the initiative was implemented: 1) whether top-down, i.e. government-driven or bottom-up, i.e. citizens-driven; 2) governance model; 3) maturity stages; 4) challenges; 5) risks; and 6) technologies.

In total, 21 initiatives were developed and documented as full case studies: 3 from Africa, 8 from the Americas, 6 from Asia and 4 from Europe. The identification, city, country and region of each case study are shown in Table 17 while details are included in Appendix C.3.

6.1.3. Interviews

Among 21 case studies, 11 were selected for interviews with experts or practitioners participating in or leading the associated initiatives. The experts or practitioners were contacted by email and sometimes by phone. Among 11 contacts, 6 interviews were conducted as showed in Table 17 below. Appendix C.4 presents the entire interview protocol including questions about the local context, changes introduced, challenges, risks, governance, and other comments concerning the initiatives in question, and Appendix C.5 includes the transcripts of the interviews including answers to these questions.

Table 17: Smart City Case Study and Interview Selection

ID	CITY	COUNTRY	REGION	SELECTED	INTERVIEWED
ID001	Bangalore	India	Asia	No	No
ID002	Cyberjaya	Malaysia	Asia	No	No
ID003	Eko Atlantic City	Nigeria	Africa	No	No
ID004	Konza	Kenya	Africa	No	No
ID005	Petronia	Ghana	Africa	Yes	No
ID006	Singapore	Singapore	Asia	Yes	Yes
ID007	Ho Chi Minh	Vietnam	Asia	Yes	No
ID008	Mexico City	Mexico	Americas	Yes	No
ID009	Montevideo	Uruguay	Americas	Yes	Yes
ID010	Bogotá	Colombia	Americas	Yes	Yes
ID011	Medellin	Colombia	Americas	Yes	Yes
ID012	Curitiba	Brazil	Americas	Yes	Yes
ID013	Barcelona	Spain	Europe	Yes	No
ID014	Skolkovo	Russia	Europe	Yes	No
ID015	Amsterdam	Netherlands	Europe	No	No
ID016	Seattle	United States	Americas	No	No
ID017	New York	United States	Americas	No	No
ID018	Guadalajara	Mexico	Americas	No	No
ID019	Hong Kong	China	Asia	No	No
ID020	Tianjin	China	Asia	No	No
ID021	Guimarães	Portugal	Europe	Yes	Yes

6.2. Quantitative Analysis

The quantitative analysis of the 119 identified Smart City initiatives is carried out along 5 case study-specific aspects and the findings are included in the corresponding sections: dimensions – Section 6.2.1, organizations – Section 6.2.2, countries – Section 6.2.3, types – Section 6.2.4 and approaches – Section 6.2.5. The five aspects are different than those used in the quantitative analysis of the research and policy literature reviews in Sections 4 and 5.

6.2.1. Aspect 1 – Dimensions

The Dimensions Aspect analyzes the objectives and nature of Smart City initiatives, i.e. whether they advance the Smart People, Smart Living, Smart Economy, Smart Mobility, Smart Environment, or Smart Governance dimensions of a Smart City. According to Figure 43, the dimensions most often covered by the Smart City initiatives are: Smart Living at 25%, followed by Smart Environment at 21%, Smart Economy at 19%, Smart Mobility at 13%, Smart Governance at 13%, and Smart People at 9%.

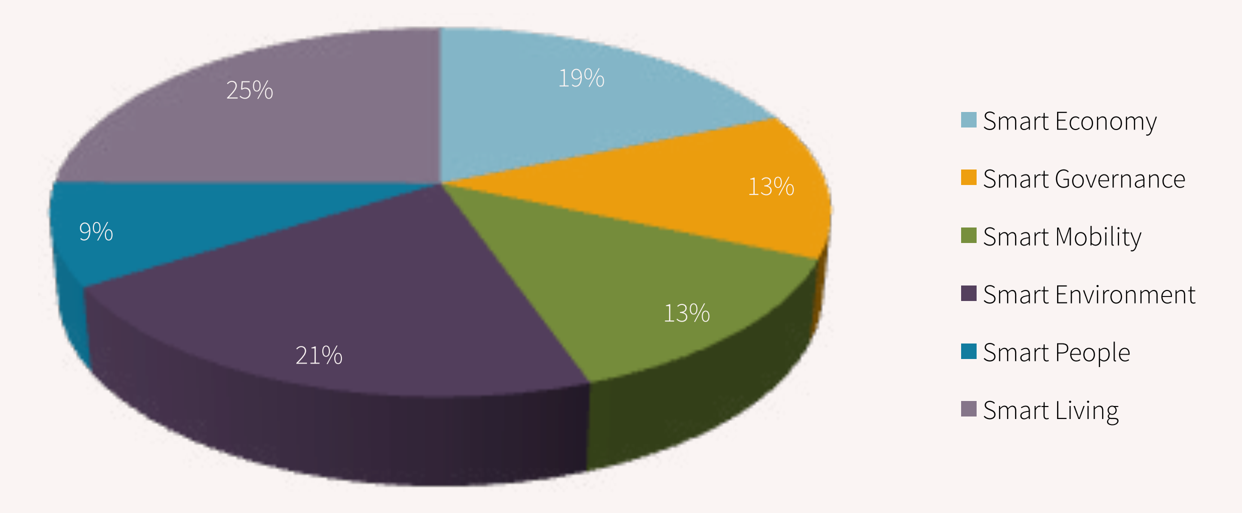

Figure 43: Case Study Quantitative Analysis, Aspect 1 – Dimensions

The developing-developed country comparison, depicted in Figure 44, shows that Smart Living is the most common dimension of Smart City initiatives in developing countries, with 38 versus 34 initiatives in developing and developed countries respectively, followed by Smart Economy with 32 versus 22 initiatives, Smart Environment with 27 versus 35 initiatives – the only dimension where developed countries have more initiatives than developing countries, Smart Mobility with 21 versus 17 initiatives, Smart Governance with 20 versus 17 initiatives, and Smart People with 13 initiatives each.

Figure 44: Case Study Quantitative Analysis, Aspect 1 – Dimensions and Development

In terms of the number of dimensions covered by individual initiatives, 40% of the initiatives cover one dimension, 24% cover two dimensions, and 12%, 9%, 7% and 8% cover three, four, five and six dimensions respectively. The percentages are depicted in Figure 45.

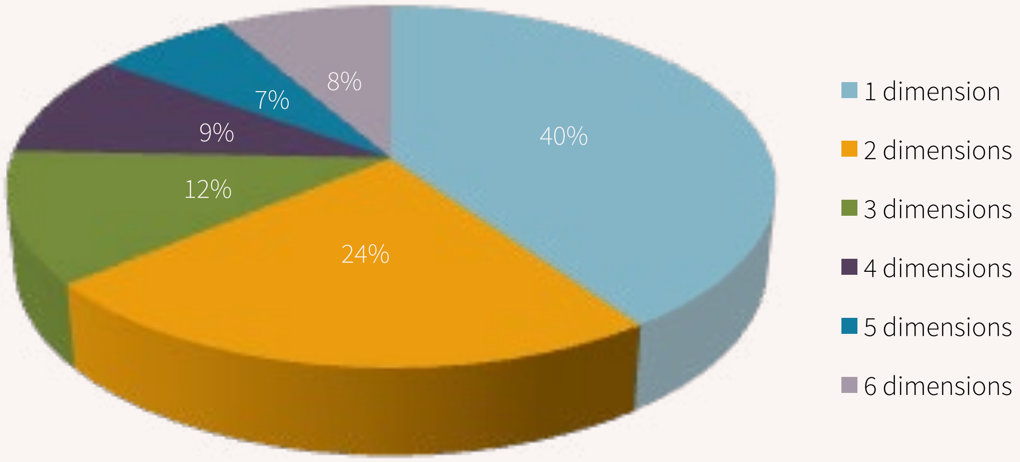

Figure 45: Case Study Quantitative Analysis, Aspect 1 – Multiple Dimensions

The comparison of the multi-dimensionality of Smart City initiatives between developing and developed countries is depicted in Figure 46. In general, there are more single-dimensional initiatives in developed countries (27) compared to developing countries (20) but there are more multi-dimensional initiatives in developing countries (38) than in developed countries (33). Specifically, 16 versus 12 initiatives with two dimensions, 5 versus 9 initiatives with three dimensions, 8 versus 3 initiatives with four dimensions, 2 versus 6 initiatives with five dimensions and 7 versus 3 initiatives with all six dimensions.

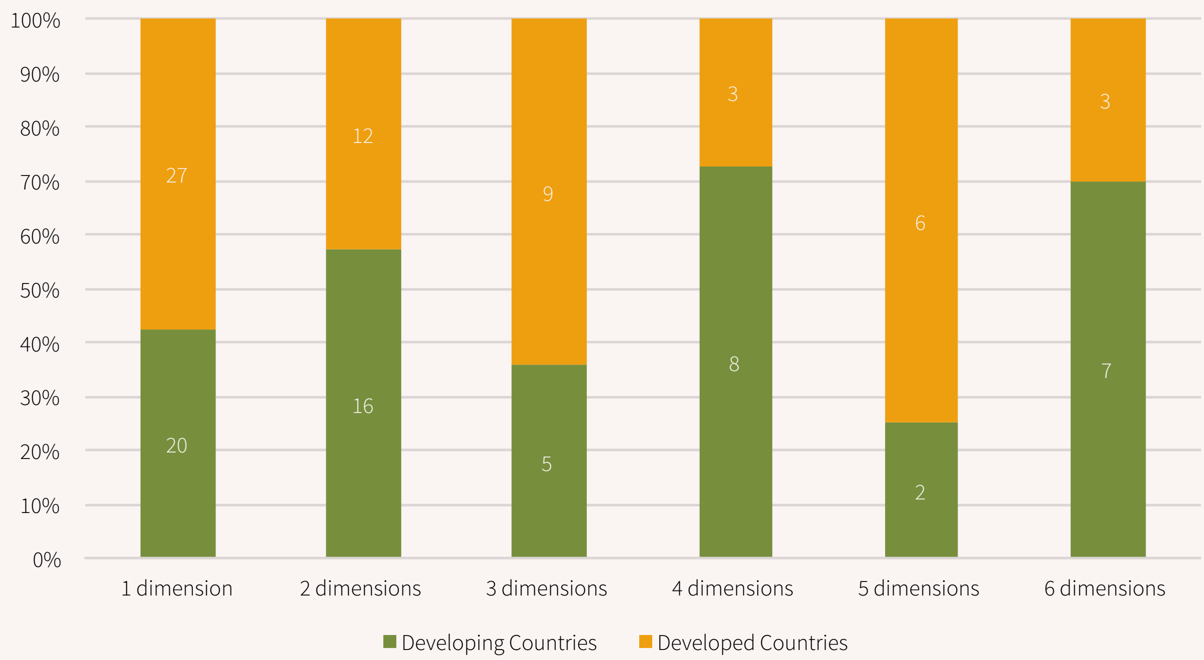

Figure 46: Case Study Quantitative Analysis, Aspect 1 – Multiple Dimensions and Development

6.2.2. Aspect 2 – Organizations

The Organizations Aspect determines the type of organizations – government, industrial or non-governmental – responsible for implementing Smart City initiatives. As depicted in Figure 47, among 164 organizations involved, 109 (66%) are government organizations, 31 (19%) are industrial organizations and 24 (15%) are non-governmental organizations. Comparing developing and developed countries, the numbers of government organizations are roughly the same for both types of countries (53 versus 56), and the same for industrial organizations (15 versus 16), but the number of non-governmental organizations in developed countries (16) doubles the same number in developing countries (8).

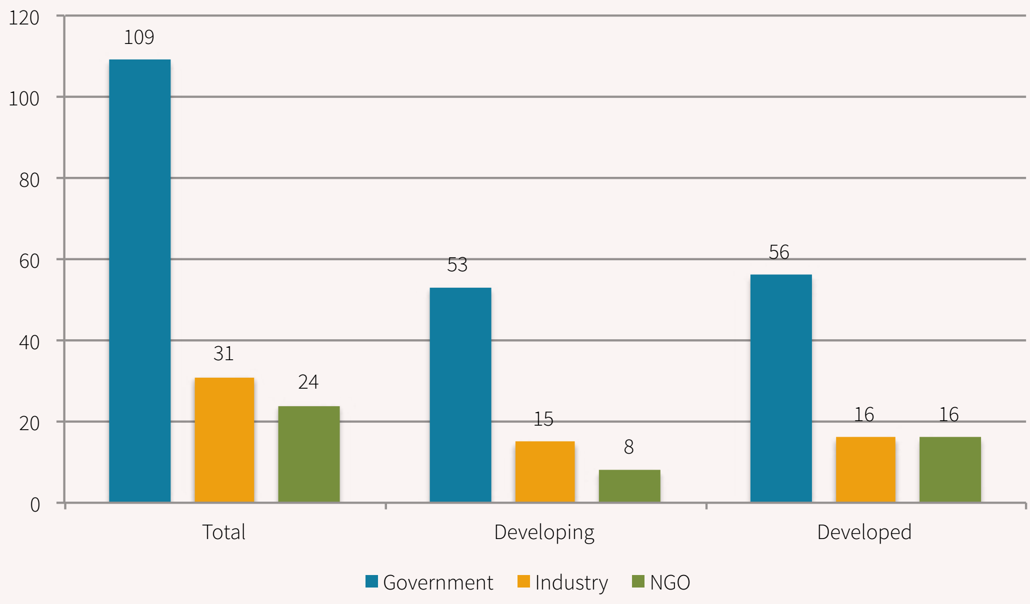

Figure 47: Case Study Quantitative Analysis, Aspect 2 – Organization Types

Figure 48 depicts the type of sectoral or multi-sectoral partnerships responsible for conducting Smart City initiatives. Most of the initiatives, i.e. 85 or 71% were performed by single-sector organizations: 76 by government, 4 by industrial, and 5 by non-governmental organizations; 23 or 19% by two-sectoral partnerships including government-industry, government-NGO or industry-NGO partnerships and only 11 or 9% by the partnerships involving all three sectors. The figure also compares multi-sectoral partnerships taking place in developing and developed countries, with double the number of government-industry partnerships in developing countries, i.e. 10 versus 5, and less than half the number of three-sectoral partnerships in developing countries, i.e. 3 versus 8.

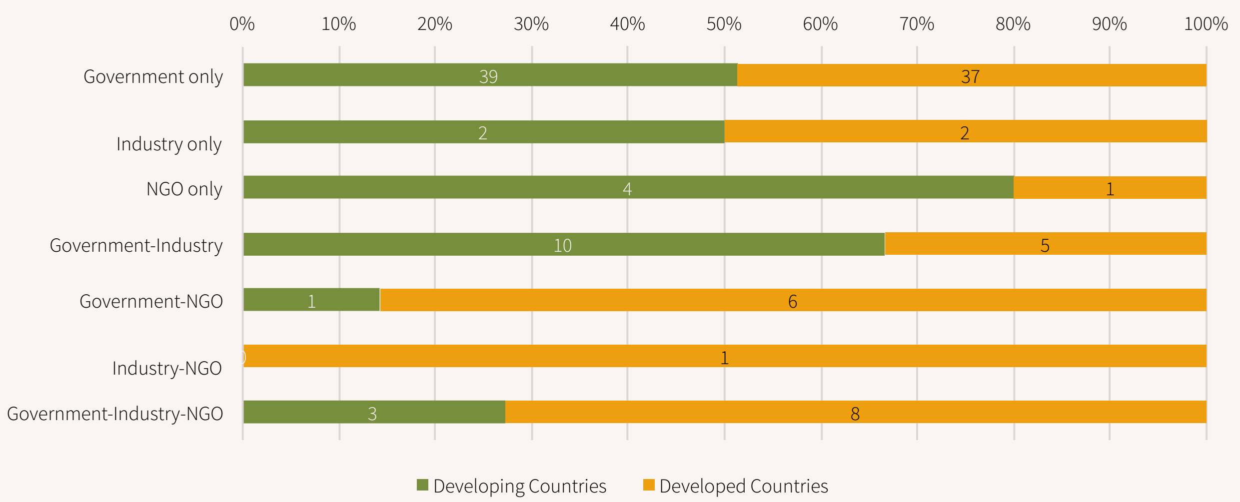

Figure 48: Case Study Quantitative Analysis, Aspect 2 – Multi-Sectorial Partnerships

6.2.3. Aspect 3 – Countries

The Countries Aspect determines where the Smart City initiatives were conducted. In total, the 119 Smart City initiatives were hosted by 49 countries and territories. As depicted in Figure 49, the largest number of initiatives came from the USA (11), followed by the Republic of Korea (8) and China (6), followed by Germany and the UK at 5 initiatives each.

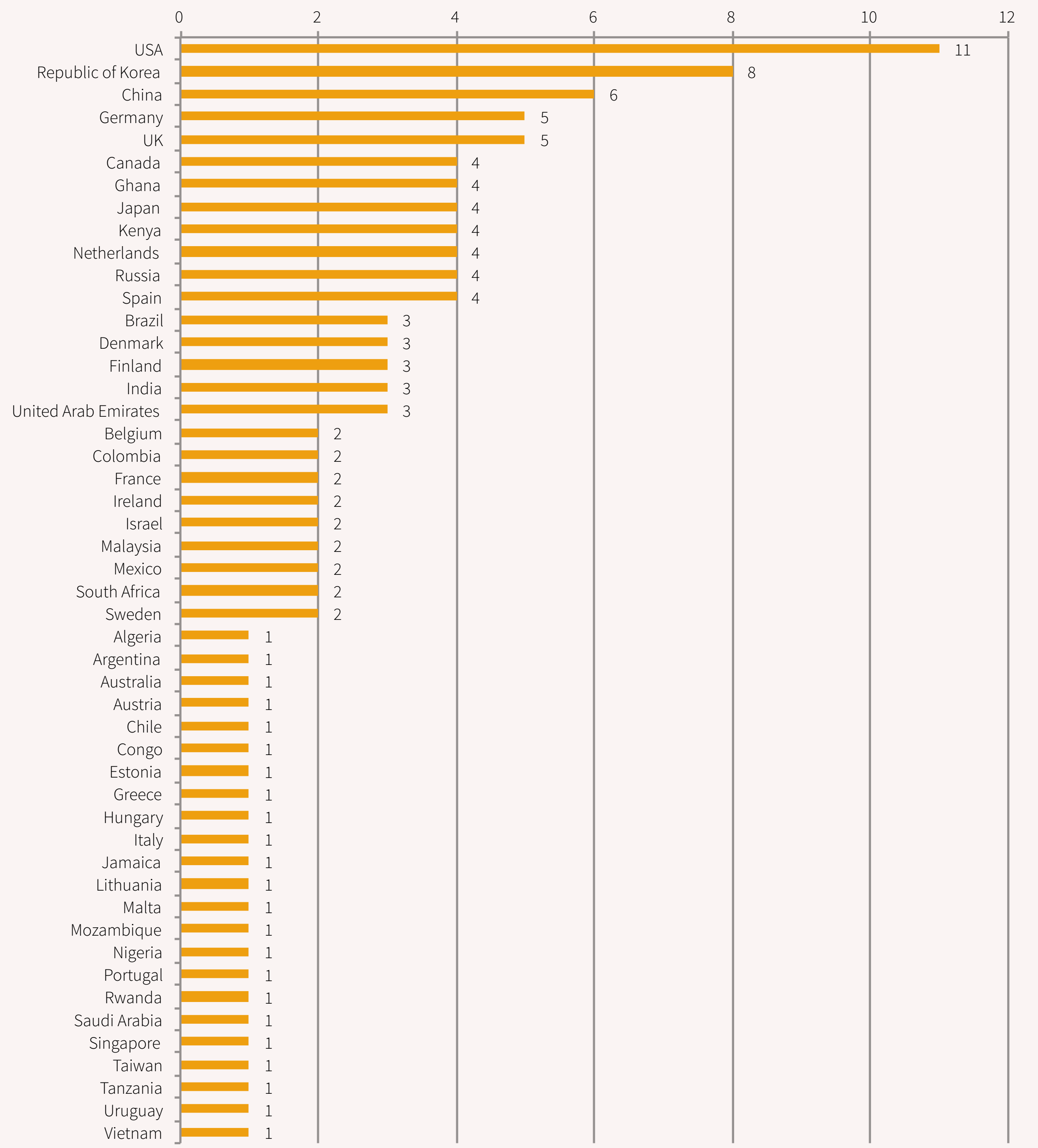

Figure 49: Case Study Quantitative Analysis, Aspect 3 – Countries

About half of the initiatives, i.e. 59 or 50% are from developing countries and another half, i.e. 60 or 50% from developed countries. Concerning regions, according to Figure 50, the largest number of initiatives were conducted in Europe (37%), followed by Asia Pacific (28%), Africa (13%), North America (13%) and Latin America and the Caribbean (9%). Among 16 initiatives in Africa, 6 are from East Africa, 5 from West Africa, 3 from Southern Africa and 1 each from North and Central Africa.

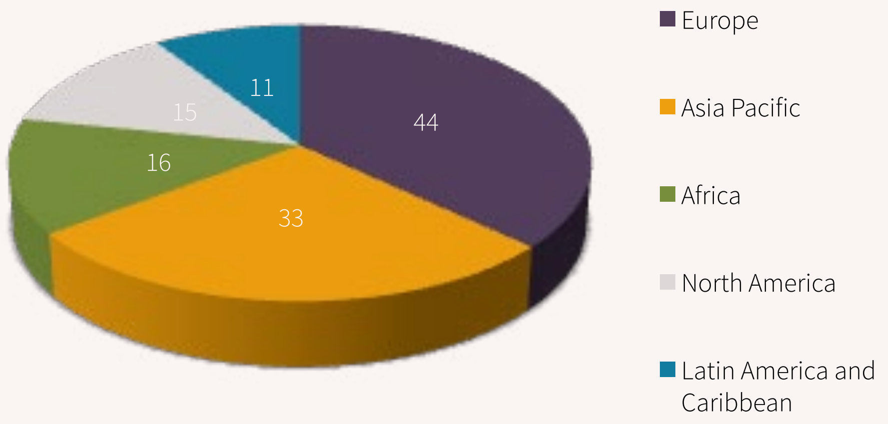

Figure 50: Case Study Quantitative Analysis, Aspect 3 – Regions

6.2.4. Aspect 4 – Types

The Type Aspect determines if an initiative concerns Smart City planning or implementation. As shown in Figure 51, planning-type initiatives in developing countries exceed those in developed countries (38 versus 32) countries, while implementation-type initiatives in developed countries exceed those in developing countries (28 versus 19).

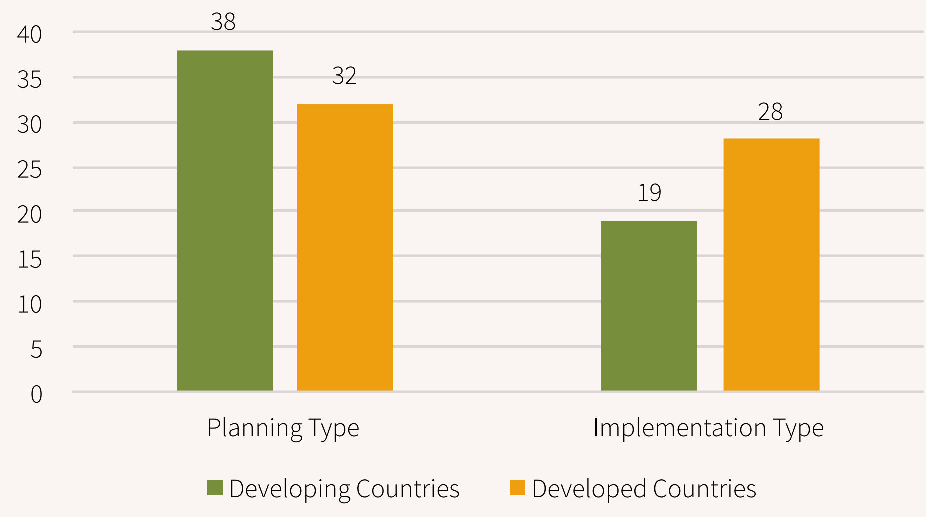

Figure 51: Case Study Quantitative Analysis, Aspect 4 – Planning versus Implementation

6.2.5. Aspect 5 – Approaches

The Approach Aspect determines the approach adopted to conducting a Smart City initiative, whether top-down (government-led) approach or a bottom-up (citizen-driven) approach. According to Figure 52, top-down initiatives are more frequent in developing countries (52) compared to developed countries (45) while bottom-up initiatives are more frequent in developed countries (8) compared to developing countries (3).

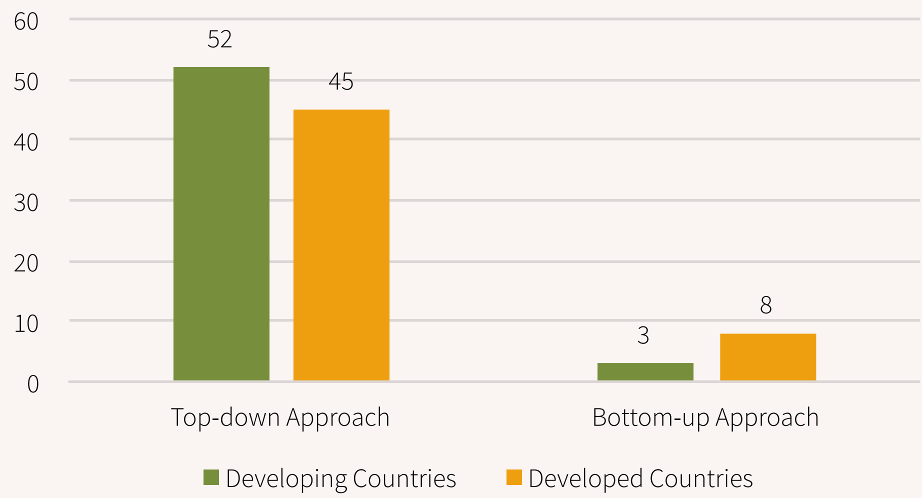

Figure 52: Case Study Quantitative Analysis, Aspect 5 – Top-down versus Bottom-up

6.3. Qualitative Analysis

Following the quantitative analysis of all 119 Smart City initiatives, this section presents the qualitative analysis of the 21 initiatives selected among them and developed into full Smart City case studies. The analysis generally aimed at establishing how the case studies address each of the 13 Smart City Attributes derived from the project's terms of reference and further study, the same set of Attributes applied to analyze research and policy literature reviews in Sections 4 and 5. The result are outlined in subsequent sections:

1. Values – Section 6.3.1;
2. Drivers – Section 6.3.2;
3. Challenges – Section 6.3.3;
4. Risks – Section 6.3.4;
5. Regions – Section 6.3.5;
6. Technologies – Section 6.3.6;
7. Tools – Section 6.3.7;
8. Approaches – Section 6.3.8;
9. Stakeholders – Section 6.3.9;
10. Governance – Section 6.3.10;
11. Maturity models – Section 6.3.11;
12. Innovations – Section 6.3.12; and
13. Benefits – Section 6.3.13.

The analysis was carried out with support from the spreadsheet tool Excel developed by Microsoft and the mind mapping and brainstorming tool XMind developed by XMind Ltd.

6.3.1. Attribute 1 – Values

The analysis of the 21 case studies identified 44 values underpinning Smart City initiatives. The values are organized into ten categories depicted in Figure 53: Quality of Life (1 value); Economic (2 values),; Regional (3 values); City Attributes (5 values); Social (10 values); Governance (4 values); Environment (1 value); Human

Capital (5 values); and Infrastructure (6 values); and Services (7 values). The full list of values is included in Table 18.

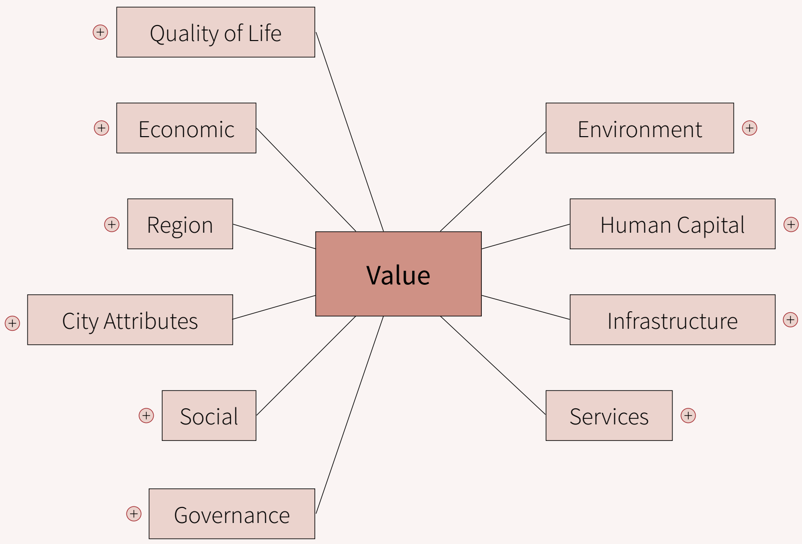

Figure 53: Case Study Qualitative Analysis, Attribute 1 – Values Conceptual Map

Table 18: Case Study Qualitative Analysis, Attribute 1 – Instances of Values

ID	TYPE	DESCRIPTION
VA1	Environment	Sustainable environment
VA2	Human Capital	Connected learning
VA3	Human Capital	Collaboration for human capacity-building
VA4	Human Capital	Knowledge –transfer
VA5	Human Capital	Entrepreneur culture
VA6	Human Capital	Do-it-yourself approach
VA7	Infrastructure	Recreation and relaxation rooms
VA8	Infrastructure	Efficient energy management system
VA9	Infrastructure	Smart buildings
VA10	Infrastructure	Smart waste management
VA11	Infrastructure	Show-room of Africa natural resources for investors
VA12	Infrastructure	Enhanced quality of public transport
VA13	Services	Smart parking
VA14	Services	Connected cafes
VA15	Services	Safety and security systems in public spaces
VA16	Services	Access to a remote expert
VA17	Services	Eco-labelling for products
VA18	Services	Innovative solutions
VA19	Services	Creative solutions
VA20	Governance	Citizens' voice
VA21	Governance	Consensual decision-making

VA22	Governance	Empowered participation
VA23	Governance	Co-creation of solutions
VA24	Social	Promotion of “common” cultural values
VA25	Social	Inclusive society
VA26	Social	Common collective goal for the society
VA27	Social	Sustainable consumption
VA28	Social	Equal and fair society
VA29	Social	Honest behavior
VA30	Social	Responsible actions
VA31	Social	Openness and Transparency
VA32	Social	Increased sense of belonging
VA33	Social	Harmonious society
VA34	City Attributes	Sustainable city development
VA35	City Attributes	Social, livable and vibrant city
VA36	City Attributes	Clean, healthy and safe city
VA37	City Attributes	Responsive city
VA38	City Attributes	Proximity from home to working places
VA39	Region	Sustainable region
VA40	Region	Regenerated region
VA41	Region	Scale-up to region level
VA42	Economic	Increased shareholders’ value
VA43	Economic	Revenues from increased costumers of a better public transport
VA44	Quality of Life	Enhanced mobility of citizens

Table 19 shows which of the value categories defined in Figure 53 are adopted by which of the 21 case studies. As the summary located at the bottom of Table 19 highlights, the largest number of case studies adopted the Services category (10), followed by the Social (8), City Attributes (6), Human Capital (5), Infrastructure (4), Environment (3), Governance (3), Economic (2), Region (2) and Quality of Life (1) categories. The table also depicts how many value categories were adopted by case studies from developing versus developed countries.

Table 19: Case Study Qualitative Analysis, Attribute 1 – Values per Case Study

ID	CITY	DEVELOPMENT	VALUES									
			QUALITY OF LIFE	ECONOMIC	REGION	CITY ATTRIBUTES	SOCIAL	GOVERNANCE	ENVIRONMENT	HUMAN CAPITAL	INFRASTRUCTURE	SERVICES
ID001	Bangalore	developing				x				x	x	x
ID002	Cyberjaya	developing				x	x				x	
ID003	Eko Atlantic	developing			x	x						

ID004	Konza	developing				x						
ID005	Petronia	developing		x							x	
ID006	Singapore	developed										
ID007	Ho Chi Minh	developing					x			x		x
ID008	Mexico City	developing								x		
ID009	Montevideo	developing		x							x	
ID010	Bogotá	developing					x	x				
ID011	Medellin	developing	x									
ID012	Curitiba	developing					x					
ID013	Barcelona	developed				x	x		x			x
ID014	Skolkovo	developing								x		x
ID015	Amsterdam	developed			x			x		x		x
ID016	Seattle	developed										x
ID017	New York	developed					x					x
ID018	Guadalajara	developing										x
ID019	Hong Kong	developed						x	x			x
ID020	Tianjin	developing					x		x			x
ID021	Guimarães	developed				x	x					
TOTAL CASES		developing	1	2	1	4	5	1	1	4	4	5
		developed	0	0	1	2	3	2	2	1	0	5
		All	1	2	2	6	8	3	3	5	4	10

According to Figure 54, developing and developed countries include equal numbers of case studies that emphasize the values in the Social Category (5 case studies each) and the Region Category (1 case study each), developed countries include more case studies that developing countries in the Governance (2 versus 1) and Environment (2 versus 1) Categories, and developing countries include more case studies than developed countries in all remaining categories, i.e. Social (5 versus 3), City Attributes (4 versus 2), Human Capital (4 versus 1), Infrastructure (4 versus 0), Economic (2 versus 0) and Quality of Life (1 versus 0) categories. From the analysis, Social, Services, City Attributes, Human Capital and Infrastructure dominate as sources of value for Smart City case studies from developing countries.

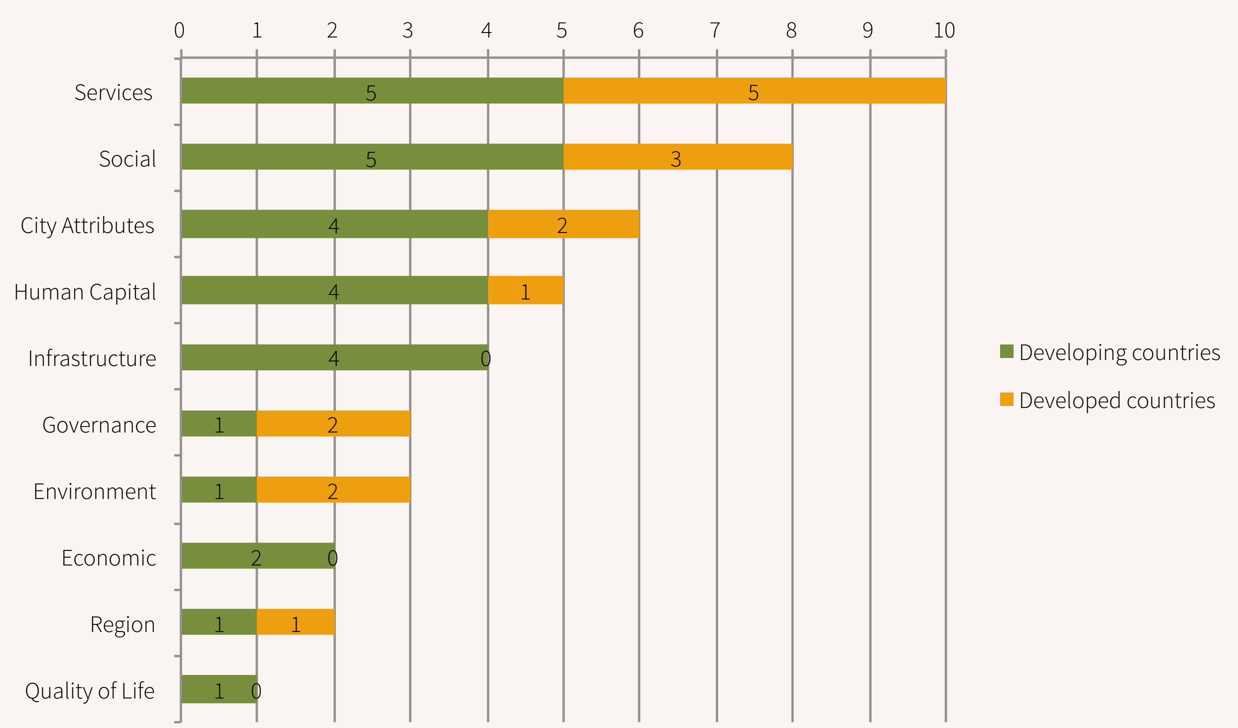

Figure 54: Case Study Qualitative Analysis, Atribute 1 – Values and Development

6.3.2. Attribute 2 – Drivers

The analysis of the 21 case studies identified 76 drivers underpinning Smart City initiatives. The drivers are organized into six categories depicted in Figure 55: Environment (17 drivers), Social (14 drivers), Quality of Life (15 drivers), Mobility (8 drivers), Governance (9 drivers) and Economic (12 drivers). The full list of drivers is included in Table 20.

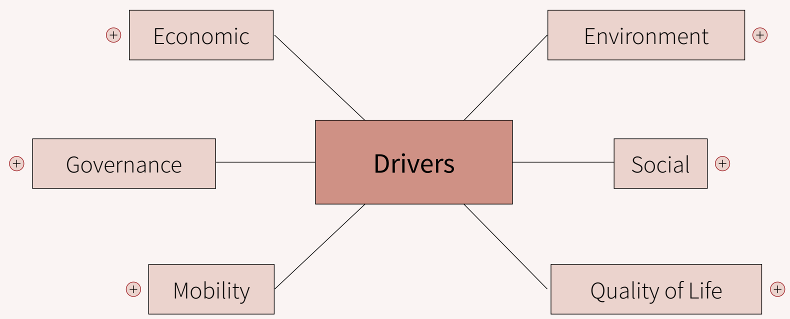

Figure 55: Case Study Qualitative Analysis, Attribute 2 – Drivers Conceptual Map

Table 20: Case Study Qualitative Analysis, Attribute 2 – Instances of Drivers

ID	TYPE	DESCRIPTION
DR1	Economic	Developing an environment for creation of economic activities
DR2	Economic	Creating job opportunities in the IT industry
DR3	Economic	Contributing to transforming the country into a powerful global economy
DR4	Economic	Attracting international companies to bring competent human resources

DR5	Economic	Creating a sustainable, world-class technology hub
DR6	Economic	Positioning the city as an international platform for mining and energy industries
DR7	Economic	Be the number one of ICT industry in the global marketplace
DR8	Economic	Increasing two-fold the value of ICT industry and three-fold ICT exportations
DR9	Economic	Creating 80,000 new jobs
DR10	Economic	Fostering economic development by greening existing sectors by using energy and natural resources efficiently
DR11	Economic	Stimulating innovations in ICT, bio-, aerospace, energy and nuclear technologies
DR12	Economic	Developing a digital creative city to boost economic growth
DR13	Governance	Promoting citizen-centric and efficient governance
DR14	Governance	Promoting accountable and transparent governance
DR15	Governance	Delivering an efficient urban management system
DR16	Governance	Improving citizens' access to public services and participation
DR17	Governance	Releasing more data-sets to the public
DR18	Governance	Encouraging the co-creation of smart city
DR19	Governance	Improving e-participation in public affairs
DR20	Governance	Improving service delivery in specific government sectors, like justice, education, health, finances and transport
DR21	Governance	Consolidating a governance model with private sector involvement
DR22	Governance	Governance role in promoting attractiveness for leveraging investments, high growth business, creativeness, risk-taking and social innovation
DR23	Mobility	Delivering a cost efficient and intelligent urban mobility system
DR24	Mobility	Building a world-class hub to serve the daily commuters
DR25	Mobility	Enhancing real-time bus information
DR26	Mobility	Achieving cleaner and greener transport through green innovative technologies
DR27	Mobility	Implementing and deploying ICT in city transport systems
DR28	Mobility	Improving mobility of people in peripheral areas
DR29	Mobility	To be a reference in innovative solutions for efficient urban mobility management
DR30	Mobility	Guaranteeing green urban mobility
DR31	Environment	Delivering effective waste treatment ensuring efficient collection and disposal
DR32	Environment	Reducing carbon emissions
DR33	Environment	Protecting the coast line of the city
DR34	Environment	Building eco-friendly energy infrastructures
DR35	Environment	Reducing pollution
DR36	Environment	Ensuring a sustainable environment
DR37	Environment	Achieving resource sustainability
DR38	Environment	Delivering effective drainage
DR39	Environment	Using clean and renewable energy
DR40	Environment	Encouraging responsible behavior for mobility, production and consumption, respecting natural and cultural heritage resources

DR41	Environment	Providing reference tools for boosting the green economy
DR42	Environment	Obtaining prudent management of energy and water resources
DR43	Environment	Measuring and reducing environmental impact of buildings
DR44	Environment	Implementing inspection system for constructions
DR45	Environment	Making city parks a sustainable, green, innovative and enjoyable space
DR46	Environment	Ensuring clean water
DR47	Environment	Protecting urban biodiversity and enhancing natural resilience
DR48	Social	Having high education schools in every neighborhoods
DR49	Social	Delivering online content and e-education
DR50	Social	Delivering high quality healthcare facilities
DR51	Social	Implementing electronic health records for every resident
DR52	Social	Providing access to telemedicine in every neighborhood
DR53	Social	Delivering effective health care
DR54	Social	Promoting marriages among single people
DR55	Social	Promoting gender-equal legal rights
DR56	Social	Conducting research to apply green technologies for more efficient use of natural resources
DR57	Social	Ensuring universal, equal and affordable access to services through ICT
DR58	Social	Developing citizens' digital competences
DR59	Social	Advancing social and business commitment towards a sustainable and collaborative culture
DR60	Social	Creating an environment that attracts and retains creative people and companies
DR61	Social	Promoting social inclusion, social development and community spirit
DR62	Quality of Life	Ensuring affordable housing
DR63	Quality of Life	Deploying cost efficient physical and social infrastructure - e.g. water and energy supply, sanitation
DR64	Quality of Life	Enhancing quality of education
DR65	Quality of Life	Delivering dependable security services
DR66	Quality of Life	Providing access to sport facilities
DR67	Quality of Life	Deploying robust and high speed interconnectivity
DR68	Quality of Life	Ensuring efficient urban mobility for better quality of life
DR69	Quality of Life	Deploying an ubiquitous communication network
DR70	Quality of Life	Ensuring better quality of life for citizens
DR71	Quality of Life	Building infrastructures for commercial and residential areas, and world-class recreational facilities
DR72	Quality of Life	Saving citizens' time, effort and cost for daily life activities
DR73	Quality of Life	Improving people's quality of life by creating an environmentally friendly lifestyle
DR74	Quality of Life	Building green spaces
DR75	Quality of Life	Creating a high quality urban model of living that seamlessly integrates adequate zoning for living, commerce and entertainment
DR76	Quality of Life	Ensuring opportunities for personal development and creative social realization

Table 21 shows which of the Driver Categories defined in Figure 55 are adopted by which of the 21 case studies. As the summary located at the bottom of Table 21 highlights, the largest number of case studies adopted the Environment category (14), followed by Quality of Life (13), Economic (11), Mobility (9), Governance (8) and Social (5) Drivers Categories. The table also depicts how many Driver Categories were adopted by the case studies from developing countries versus the case studies from developed countries.

Table 21: Case Study Qualitative Analysis, Attribute 2 – Drivers per Case Study

ID	CITY	DEVELOPMENT	DRIVERS					
			ECONOMIC	GOVERNANCE	MOBILITY	ENVIRONMENT	SOCIAL	QUALITY OF LIFE
ID001	Bangalore	developing	x	x	x	x	x	x
ID002	Cyberjaya	developing	x	x		x		
ID003	Eko Atlantic City	developing	x			x		x
ID004	Konza	developing	x	x		x		x
ID005	Petronia	developing	x		x	x		x
ID006	Singapore	developed	x	x	x	x		x
ID007	Ho Chi Minh	developing	x			x	x	x
ID008	Mexico City	developing	x	x	x		x	x
ID009	Montevideo	developing			x			
ID010	Bogotá	developing					x	
ID011	Medellin	developing			x			x
ID012	Curitiba	developing			x			x
ID013	Barcelona	developed				x		
ID014	Skolkovo	developing	x			x		
ID015	Amsterdam	developed						x
ID016	Seattle	developed				x		x
ID017	New York	developed		x				
ID018	Guadalajara	developing	x	x	x	x	x	x
ID019	Hong Kong	developed				x		
ID020	Tianjin	developing				x		
ID021	Guimarães	developed	x	x	x	x		x
TOTAL CASES		developing	9	5	7	9	5	9
		developed	2	3	2	5	0	4
		All	11	8	9	14	5	13

According to Figure 56, developing countries include a greater number of case studies than developed countries in all driver categories: Environment (9 versus 5 case studies); Quality of Life (9 versus 4 case studies); Economic (9 versus 2 case studies),; Mobility (7 versus 2 case studies); Governance (5 versus 3 case studies); and Social (5 versus 0 case studies). From the analysis, Environment, Quality of Life and Economic are dominant sources of drivers for Smart City case studies from developing countries.

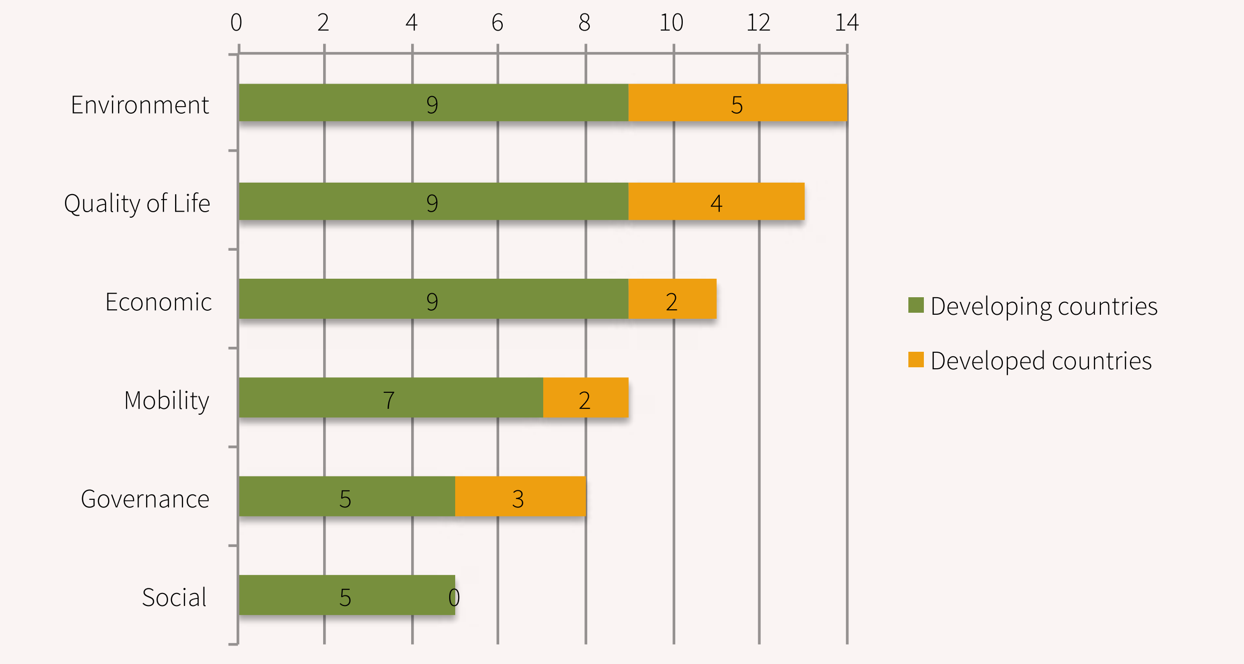

Figure 56: Case Study Qualitative Analysis, Attribute 2 – Drivers and Development

6.3.3. Attribute 3 – Challenges

The analysis of the 21 case studies identified 47 challenges affecting Smart City initiatives. The challenges are organized into nine categories depicted in Figure 57: Financial (4 challenges); Technical (3 challenges); Social (6 challenges); Environmental (8 challenges); Governance (8 challenges); Quality (4 challenges); Plan and Implementation (6 challenges); Human Capital (3 challenges); and Economic (5 challenges). The full list of challenges is included in Table 18.

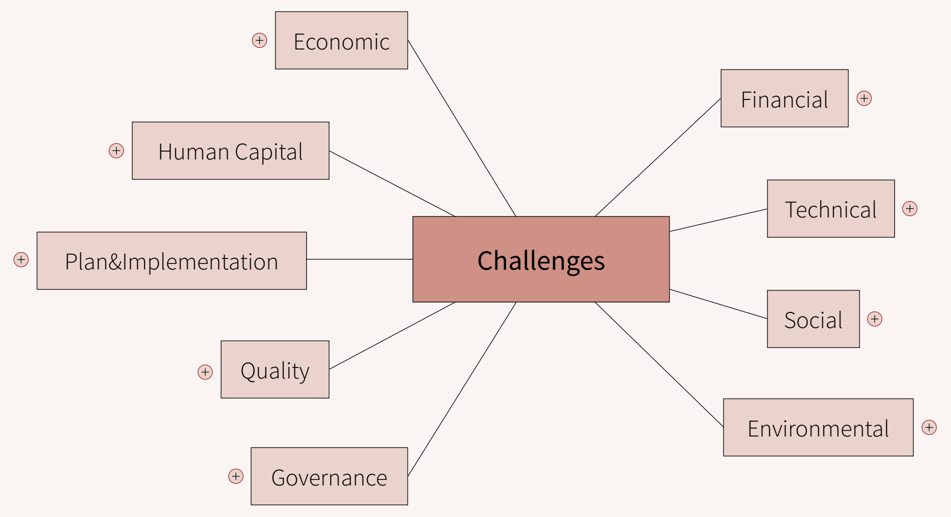

Figure 57: Case Study Qualitative Analysis, Attribute 3 – Challenges Conceptual Map

Table 22: Case Study Qualitative Analysis, Attribute 3 – Instances of Challenges		
ID	TYPE	DESCRIPTION
CH1	Economic	Improving competitiveness against international markets
CH2	Economic	Controlling wild capitalism
CH3	Economic	Achieving sustainable development only through green practices
CH4	Economic	Ensuring economic sustainability and growth
CH5	Economic	Stimulating economic development
CH6	Human Capital	Attracting qualified IT professionals and relevant IT players
CH7	Human Capital	Having qualified human resources for service delivery
CH8	Human Capital	Leveraging human capital
CH9	Plan & Implementation	Contextualizing the project/solution to the local conditions
CH10	Plan & Implementation	Integration of city infrastructure to an integrated ICT platform
CH11	Plan & Implementation	Availability of the service to different communities in the city
CH12	Plan & Implementation	Overcoming bureaucratic procedures in government agencies
CH13	Plan & Implementation	Distributed implementation and central coordination
CH14	Plan & Implementation	Producing a scalable solution
CH15	Quality	Ensuring 24x7 service availability
CH16	Quality	Ensuring customers' satisfaction
CH17	Quality	Maintaining data and data-sets up to date
CH18	Quality	Ensuring the construction of comfortable buildings/facilities
CH19	Governance	Providing enough incentives for the private sector
CH20	Governance	Ensuring collaboration between partners
CH21	Governance	Engaging private sector in testing solutions
CH22	Governance	Adopting decision/proposals made by citizens
CH23	Governance	Proper roles for private sector actors – where, when, how
CH24	Governance	Attracting talents
CH25	Governance	Distributed implementation and central coordination
CH26	Governance	Governance with broad representation of levels and sectors
CH27	Financial	Ensuring availability of financial resource
CH28	Financial	Attracting investors
CH29	Financial	Ensuring the construction of cost-effective buildings/facilities
CH30	Financial	Reducing costs
CH31	Technical	Ensuring the adoption of interoperability standards
CH32	Technical	Updating new releases of services
CH33	Technical	Having the appropriate technology at the right time
CH34	Social	Ensuring social cohesion
CH35	Social	Ensuring equity and fairness among citizens
CH36	Social	Ensuring territorial cohesion
CH37	Social	Avoiding technology polarization of citizens

CH38	Social	Ensuring the development of social and cultural values
CH39	Social	Ensuring social sustainability
CH40	Environmental	Ensuring environmental sustainability
CH41	Environmental	Reducing carbon emissions
CH42	Environmental	Ensuring efficient use of natural resources
CH43	Environmental	Achieving sustainable development only through green practices
CH44	Environmental	Reducing air pollution
CH45	Environmental	Reducing oil and gas dependency
CH46	Environmental	Reducing traffic congestion
CH47	Environmental	Addressing the scarcity of natural resources

Table 23 shows which of the categories defined in Figure 57 are adopted by which of the 21 case studies. As the summary at the bottom of Table 23 highlights, the largest number of case studies adopted the Economic category (9), followed by Social (8), Environmental (8), Plan/Implementation (8), Financial (7), Governance (5), Quality (4), Technical (4) and Human Capital (3). The table also depicts how many categories of challenges were adopted by the case studies from developing countries versus the developed countries.

Table 23: Case Study Qualitative Analysis, Attribute 3 – Challenges per Case Study

ID	CITY	DEVELOPMENT	CHALLENGES								
			ECONOMIC	FINANCIAL	TECHNICAL	SOCIAL	ENVIRONMENTAL	GOVERNANCE	QUALITY	PLAN/IMPLEMENT	HUMAN CAPITAL
ID001	Bangalore	developing		x			x				
ID002	Cyberjaya	developing	x			x	x				x
ID003	Eko Atlantic City	developing	x			x				x	
ID004	Konza	developing	x			x					
ID005	Petronia	developing	x				x			x	
ID006	Singapore	developed	x				x				
ID007	Ho Chi Minh	developing	x	x			x				
ID008	Mexico City	developing	x		x	x				x	
ID009	Montevideo	developing			x	x			x		
ID010	Bogotá	developing						x			
ID011	Medellin	developing							x		
ID012	Curitiba	developing					x		x	x	
ID013	Barcelona	developed				x					
ID014	Skolkovo	developing	x	x		x					x
ID015	Amsterdam	developed						x		x	
ID016	Seattle	developed		x				x	x		

ID017	New York	developed		x	x					x	x
ID018	Guadalajara	developing						x		x	
ID019	Hong Kong	developed		x			x				
ID020	Tianjin	developing	x	x		x	x	x		x	
ID021	Guimarães	developed			x						
TOTAL CASES		developing	8	4	2	7	6	3	3	6	2
		developed	1	3	2	1	2	2	1	2	1
		All	9	7	4	8	8	5	4	8	3

According to Figure 58, developing countries include a greater number of case studies than developed countries in all categories of challenges: Economic (8 versus 1 case studies); Social (7 versus 1 case studies); Environmental (6 versus 2 case studies); Plan/Implement (6 versus 2 case studies); Financial (4 versus 3 case studies); Governance (3 versus 2 case studies); Quality (3 versus 1 case studies); and Human Capital (2 versus 1 case studies), except Technical Challenges where developing and developed countries have equal numbers of case studies (2 each). From the analysis, Economic, Social, Environmental and Plan/Implement are dominant sources of challenges for Smart City case studies from developing countries.

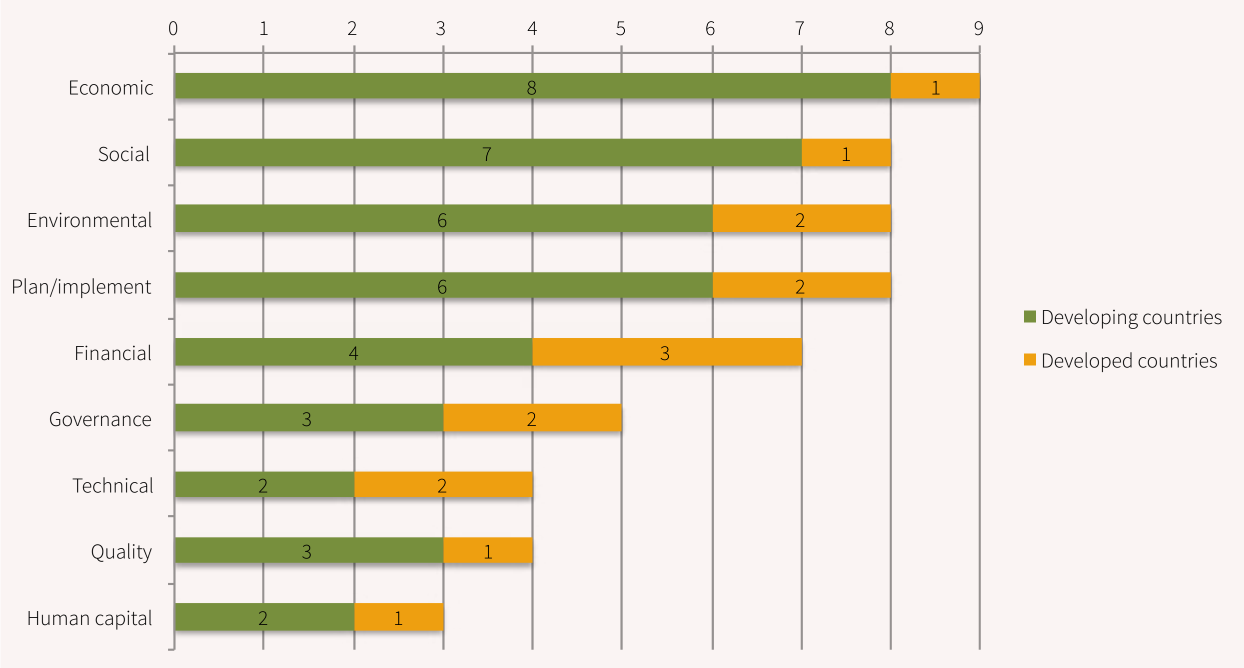

Figure 58: Case Study Qualitative Analysis, Attribute 3 – Challenges and Development

6.3.4. Attribute 4 – Risks

The analysis of the 21 case studies identified 34 possible risks facing Smart City initiatives. The risks are organized into five categories: Social (17 risks); Financial (3 risks); Technical (7 risks); Environmental (3 risks); and Economic (4 risks) depicted in Figure 59. The full list of risks is included in Table 24.

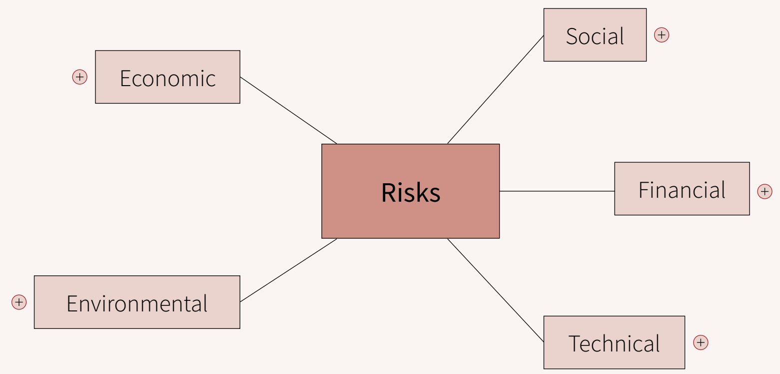

Figure 59: Case Study Qualitative Analysis, Attribute 4 – Risks Conceptual Map

Table 24: Case Study Qualitative Analysis, Attribute 4 – Instances of Risks

ID	TYPE	DESCRIPTION
RK1	Social-Divide	Deepening social polarization and gentrification
RK2	Social-Divide	Strengthening the digital divide
RK3	Social-Divide	Increasing disparities in access to health services and knowledge
RK4	Social-Exclusion	Rising citizens' feeling of exclusion due to restricted access to services
RK5	Social-Exclusion	Rising citizens' feeling of exclusion due to controlled access to places
RK6	Social-Exclusion	Social exclusion of citizens due to efforts to attract qualified foreigners
RK7	Social-Exclusion	Neglecting citizens' opinions due to political interests
RK8	Social-Exclusion	Not addressing special needs of service recipients
RK9	Social-Adoption	Delivering low take-up of services due to expensive fees
RK10	Social-Adoption	Low adaptation and flexibility capacity for adopting new solutions
RK11	Social-Adoption	Not being able to attract people for a new developed city
RK12	Social-Impact	Disregarding the social and ethical impact of ICT
RK13	Social-Impact	Negative experiences by citizens and visitors due to high surveillance
RK14	Social-Impact	A society driven by individual instead of community values
RK15	Social-Concerns	Rising citizens' concerns about privacy/security due to pervasive ICT
RK16	Social-Concerns	Promoting economic development disregarding social concerns
RK17	Social-Concerns	Facing cultural issues, e.g. lack of transparency of government
RK18	Financial	Lacking financial resources to afford the costs of initiatives
RK19	Financial	Not being able to attract investors
RK20	Financial	Not being able to efficiently collect service fees
RK21	Technical	Be driven by a very technology-centered vision
RK22	Technical	Facing cyber-attacks
RK23	Technical	Limited capacity for satisfying service transport demand
RK24	Technical	Lack of methodology to support urban related research
RK25	Technical	Generalizing results without proper contextualization
RK26	Technical	Lack of alignment among project components

RK27	Technical	Developing decoupled city infrastructure components
RK28	Environmental	Having negative environmental impact of city development
RK29	Environmental	Not achieving carbon footprint reduction to comply with Kyoto
RK30	Environmental	Promoting economic development disregarding environment concerns
RK31	Economic	Promoting economic development only based on energy resources
RK32	Economic	Developing an economy highly influenced by external factors
RK33	Economic	Promoting economic development focused only on ICT-knowledge
RK34	Economic	Developing an economy highly dependent on ICT

Table 25 shows which of the categories defined in Figure 59 are adopted by which of the 21 case studies. As the summary at the bottom of Table 25 highlights, by far the largest number of case studies adopted the Social category (16), followed by Technical (7), Financial (6), Environmental (3) and Economic (3) risks. The table also depicts how many categories were adopted by the case studies from developing countries versus the developed countries.

Table 25: Case Study Qualitative Analysis, Attribute 4 – Risks per Case Study

ID	CITY	DEVELOPMENT	RISKS				
			SOCIAL	FINANCIAL	TECHNICAL	ENVIRONMENTAL	ECONOMIC
ID001	Bangalore	developing	x		x		
ID002	Cyberjaya	developing	x				
ID003	Eko Atlantic City	developing	x				
ID004	Konza	developing	x	x			
ID005	Petronia	developing	x	x	x	x	x
ID006	Singapore	developed	x		x		x
ID007	Ho Chi Minh	developing	x			x	
ID008	Mexico City	developing	x			x	
ID009	Montevideo	developing					
ID010	Bogotá	developing	x				
ID011	Medellin	developing	x				
ID012	Curitiba	developing	x	x	x		
ID013	Barcelona	developed	x				x
ID014	Skolkovo	developing	x				
ID015	Amsterdam	developed			x		
ID016	Seattle	developed					
ID017	New York	developed	x	x			
ID018	Guadalajara	developing			x		
ID019	Hong Kong	developed	x				

ID020	Tianjin	developing	x	x	x		
ID021	Guimarães	developed		x			
TOTAL CASES		developing	12	4	5	3	1
		developed	4	2	2	0	2
		All	16	6	7	3	3

According to Figure 60, developing countries include a greater number of case studies than developed countries in all categories of risks: Social (16 versus 4 case studies); Technical (5 versus 2 case studies); Financial (4 versus 2 case studies); and Environmental (3 versus 0 case studies). The only exception is Economic risks where developed countries exceed developing countries (2 versus 1 case studies). From the analysis, Social risks dominate any other kinds of risks for Smart City case studies conducted in developing countries, and significant technical risks also exist, perhaps due to the lack of skilled professionals. The risks in developed countries are significantly lower than in developing countries.

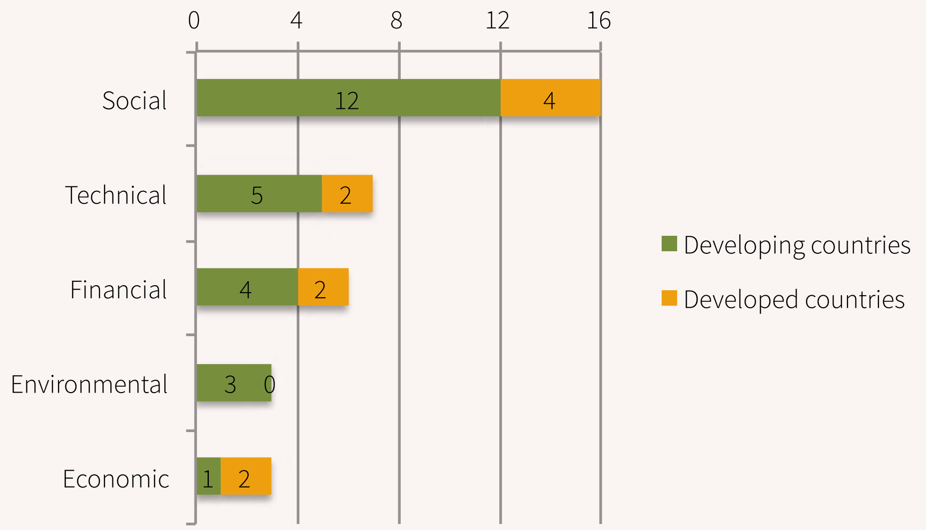

Figure 60: Case Study Qualitative Analysis, Attribute 4 – Risks and Development

6.3.5. Attribute 5 – Regions

The analysis of the 21 case studies considered three categories of the Regions Attribute: continent, development status and income level according to the World Bank classification (World Bank 2015). Table 26 provides the values of these attributes for all 21 case studies.

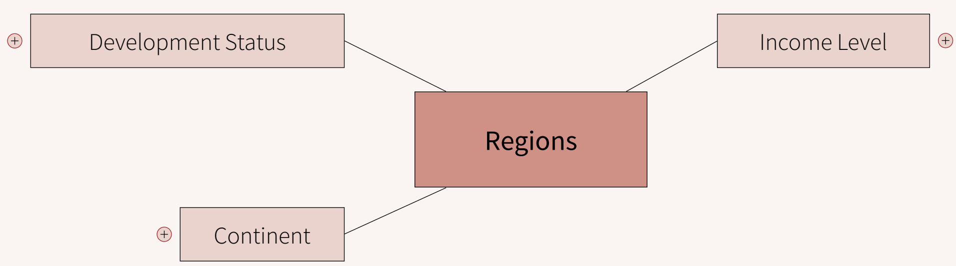

Figure 61: Case Study Qualitative Analysis, Attribute 5 – Regions Conceptual Map

Table 26: Case Study Qualitative Analysis, Attribute 5 – Regions					
ID	CITY	COUNTRY	CONTINENT	STATUS	INCOME
ID001	Bangalore	India	Asia	developing	lower middle
ID002	Cyberjaya	Malaysia	Asia	developing	upper middle
ID003	Eko Atlantic	Nigeria	Africa	developing	lower middle
ID004	Konza	Kenya	Africa	developing	low
ID005	Petronia	Ghana	Africa	developing	lower middle
ID006	Singapore	Singapore	Asia	developing	high, non-OECD
ID007	Ho Chi Minh	Vietnam	Asia	developing	lower middle
ID008	Mexico City	Mexico	Central America	developing	upper middle
ID009	Montevideo	Uruguay	South America	developing	high, non-OECD
ID010	Bogotá	Colombia	South America	developing	upper middle
ID011	Medellin	Colombia	South America	developing	upper middle
ID012	Curitiba	Brazil	South America	developing	upper middle
ID013	Barcelona	Spain	Europe	developed	high, OECD
ID014	Skolkovo	Russia	Europe	developing	high, non-OECD
ID015	Amsterdam	Netherlands	Europe	developed	high, OECD
ID016	Seattle	USA	North America	developed	high, OECD
ID017	New York	USA	North America	developed	high, OECD
ID018	Guadalajara	Mexico	Central America	developing	upper middle
ID019	Hong Kong	China	Asia	developing	upper middle
ID020	Tianjin	China	Asia	developing	upper middle
ID021	Guimarães	Portugal	Europe	developed	high, OECD

Figure 62 depicts the analysis of the 21 case studies along the three categories of the Regions Attribute. Concerning continents, the case studies are distributed all over the world: 29% of the case studies are hosted in Asia; 19% each in South America and Europe; 14% in Africa; 10% in Central America; and 9% in North America. Concerning development status; 80% of the cases studies are hosted in developing countries and 20% in developed countries, representing the focus on the projects. Concerning income levels, all World Bank categories are represented in the case studies, namely: 5% of the case studies come from low-income countries, 19% from lower middle-income countries; 38% from upper middle-income countries; 24% from high income OECD countries; and 14% from non-OECD countries.

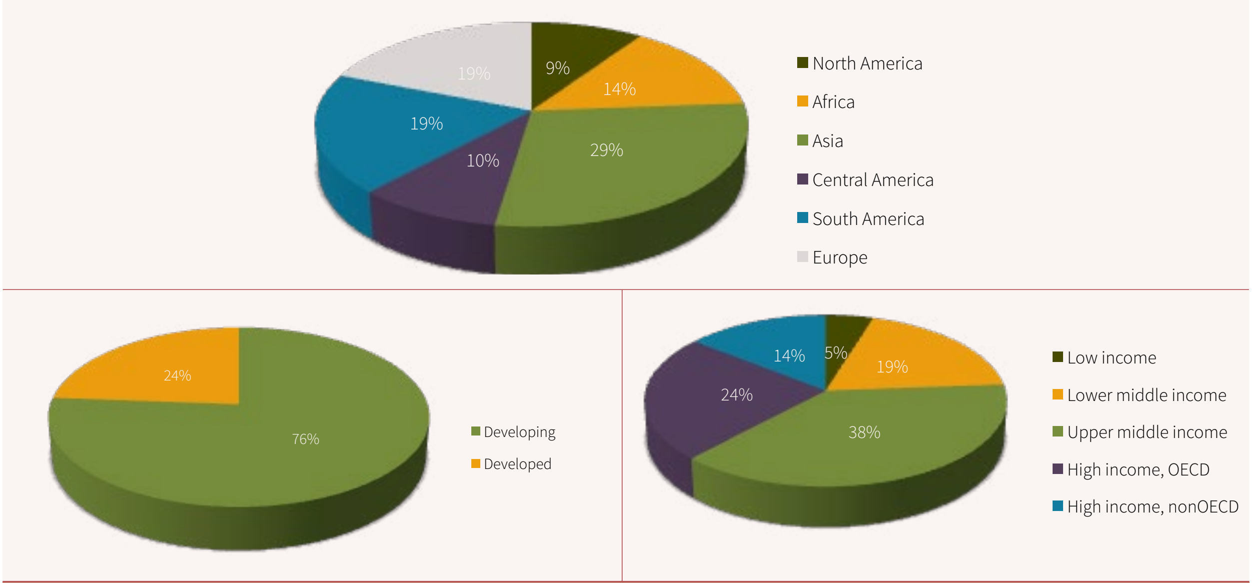

Figure 62: Case Study Qualitative Analysis, Attribute 5 – Continent, Development, Income

6.3.6. Attribute 6 – Technologies

The analysis of the 21 case studies identified 46 technologies, which were organized into five categories: ICT Software Tools (11 technologies); ICT Techniques (10 technologies); ICT Hardware Tools (3 technologies); Basic Infrastructures (8 technologies); and ICT Infrastructure Technologies (14 technologies) depicted in Figure 63. The full list of the identified technologies is presented in Table 27.

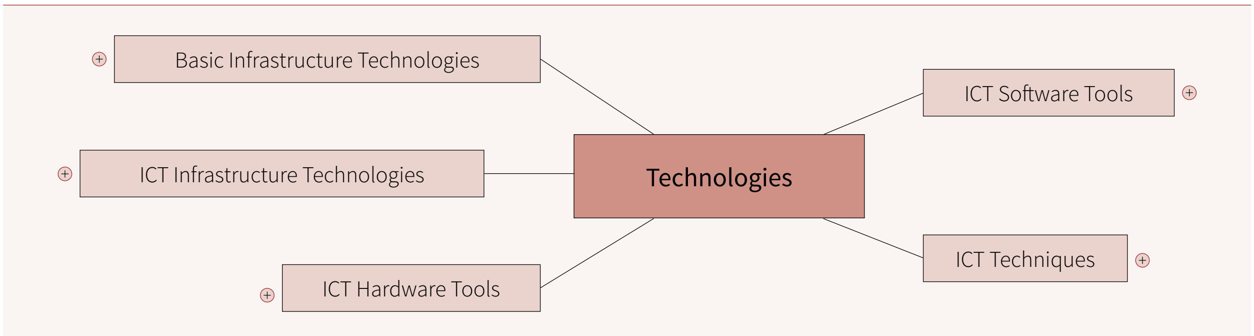

Figure 63: Case Study Qualitative Analysis, Attribute 6 – Technologies Conceptual Map

Table 27: Case Study Qualitative Analysis, Attribute 6 – Instances of Technologies

ID	TYPE	DESCRIPTION
TH1	ICT Software Tools	ICT Collaborative tools
TH2	ICT Software Tools	Video Streaming tools
TH3	ICT Software Tools	User interfaces
TH4	ICT Software Tools	e-learning tools
TH5	ICT Software Tools	Web tools
TH6	ICT Software Tools	Automated-Fare-Collection (AFC) system
TH7	ICT Software Tools	Databases
TH8	ICT Software Tools	Virtual Maps
TH9	ICT Software Tools	Mobile Apps

TH10	ICT Software Tools	Costumer relationships management systems
TH11	ICT Software Tools	Operation management tools
TH12	ICT Techniques	Reality Virtualization
TH13	ICT Techniques	Cloud Computing
TH14	ICT Techniques	Information technologies
TH15	ICT Techniques	Multimedia Technologies
TH16	ICT Techniques	Surveillance and security technologies
TH17	ICT Techniques	Data mining
TH18	ICT Techniques	Geospatial technologies
TH19	ICT Techniques	Data Analytics
TH20	ICT Techniques	Cyber-security
TH21	ICT Techniques	Big Data
TH22	ICT Hardware Tools	Sensors
TH23	ICT Hardware Tools	Smart Devices
TH24	ICT Hardware Tools	Mobile devices
TH25	Basic infrastructures	Solar Energy Technologies
TH26	Basic infrastructures	Wind Energy Technologies
TH27	Basic infrastructures	Tidal Energy Technologies
TH28	Basic infrastructures	Smart Power Grids System
TH29	Basic infrastructures	Green Material and Construction technologies
TH30	Basic infrastructures	Mechanical Technologies for Transportation
TH31	Basic infrastructures	Green Chemical Technologies
TH32	Basic infrastructures	Waste Treatment Technologies
TH33	ICT Infrastructure Technologies	Internet of Things
TH34	ICT Infrastructure Technologies	Telecom and Data Networks
TH35	ICT Infrastructure Technologies	Data Centers
TH36	ICT Infrastructure Technologies	Telecom Networks
TH37	ICT Infrastructure Technologies	IPv6
TH38	ICT Infrastructure Technologies	Future Internet
TH39	ICT Infrastructure Technologies	Wireless Networks
TH40	ICT Infrastructure Technologies	Green ICT for Agriculture, Forestry and Biology
TH41	ICT Infrastructure Technologies	Open Data Infrastructure
TH42	ICT Infrastructure Technologies	Mobile Technologies
TH43	ICT Infrastructure Technologies	Vehicle-2-Vehicle (V2V) Communication
TH44	ICT Infrastructure Technologies	Vehicle-2-Infrastructure (V2I) Communication
TH45	ICT Infrastructure Technologies	Ubiquitous Networks
TH46	ICT Infrastructure Technologies	Vehicle Prioritization Technologies

Table 28 shows which of the technology categories defined in Figure 63 are adopted by which of the 21 case studies. As the summary at the bottom of Table 28 highlights, by far the largest number of case studies adopted ICT Infrastructure Technologies (17), followed by ICT Techniques (9), ICT Software Tools (8), ICT Hardware Tools (5) and Basic infrastructures (3) categories. The table also compares how many categories were adopted by the case studies from developing countries versus the developed countries.

Table 28: Case Study Qualitative Analysis, Attribute 6 – Technologies per Case Study

ID	CITY	DEVELOPMENT	TECHNOLOGIES				
			BASIC INFRASTRUCTURES	ICT INFRASTRUCTURE TECHNOLOGIES	ICT HARDWARE TOOLS	ICT SOFTWARE TOOLS	ICT TECHNIQUES
ID001	Bangalore	developing		x		x	x
ID002	Cyberjaya	developing					x
ID003	Eko Atlantic City	developing		x			x
ID004	Konza	developing		x	x		x
ID005	Petronia	developing		x			
ID006	Singapore	developed		x		x	x
ID007	Ho Chi Minh	developing	x	x			
ID008	Mexico City	developing		x		x	x
ID009	Montevideo	developing		x	x		
ID010	Bogotá	developing		x	x	x	
ID011	Medellin	developing		x			
ID012	Curitiba	developing		x	x	x	x
ID013	Barcelona	developed		x	x	x	
ID014	Skolkovo	developing		x			x
ID015	Amsterdam	developed					
ID016	Seattle	developed	x				
ID017	New York	developed		x		x	
ID018	Guadalajara	developing		x			
ID019	Hong Kong	developed		x			x
ID020	Tianjin	developing					
ID021	Guimarães	developed	x	x		x	
TOTAL CASES		developing	1	12	4	5	7
		developed	2	5	1	3	2
		All	3	17	5	8	9

According to Figure 64, developing countries include a greater number of case studies than developed countries in all categories of technologies: ICT Infrastructure Technologies (12 versus 5 case studies); ICT Techniques (7 versus 2 case studies); ICT Software Tools (5 versus 3 case studies); and ICT Hardware Tools (4 versus 1 case studies). The only exception is Basic Infrastructure technologies where developed countries exceed developing countries at 2 versus 1 case studies. From the analysis, ICT Infrastructures Technologies are the main type of technologies used in both developing and developed countries, which indicates general awareness of the importance of developing ICT infrastructures as a means to support urbanization.

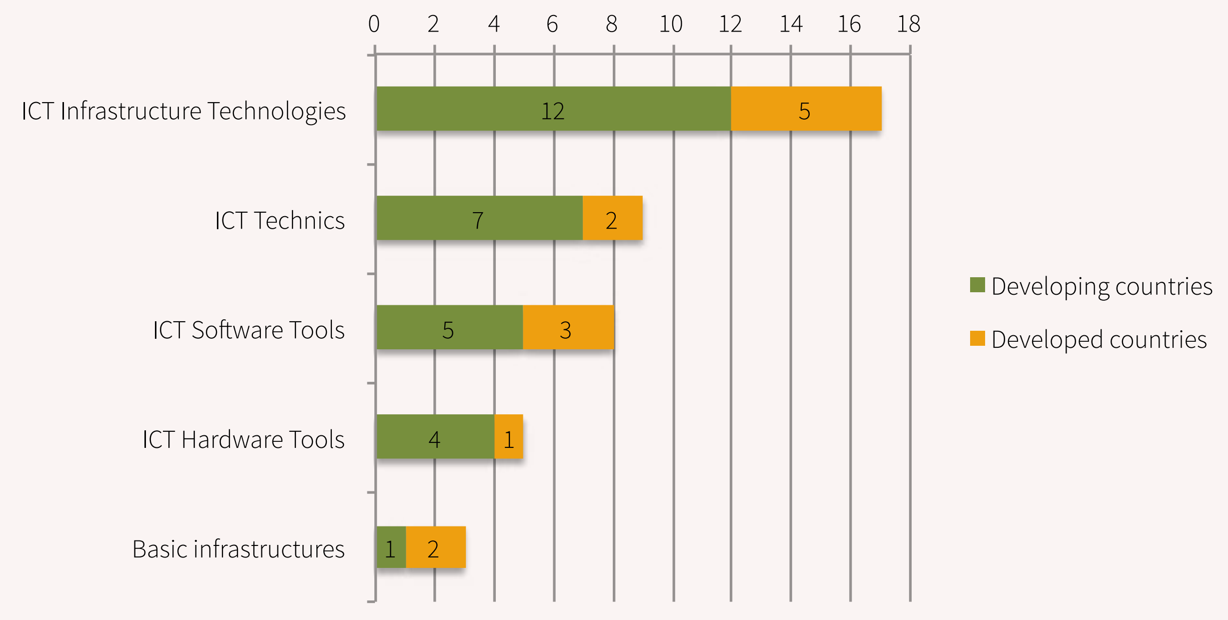

Figure 64: Case Study Qualitative Analysis, Attribute 6 – Technologies and Development

6.3.7. Attribute 7 – Tools

The analysis of the 21 case studies identified 33 tools, which were organized into five categories: Regulatory and Legal (3 tools); Planning & Implementation (5 tools); Operations (13 tools); Governance & Management (6 tools); and Monitoring (6 tools) depicted in Figure 65. The full list of the identified tools is presented in Table 29.

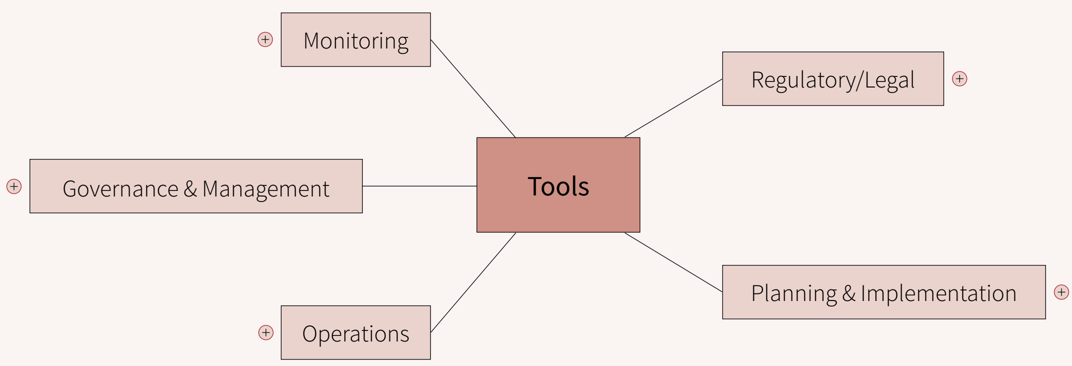

Figure 65: Case Study Qualitative Analysis, Attribute 7 – Tools Conceptual Map

Table 29: Case Study Qualitative Analysis, Attribute 7 – Instances of Tools		
ID	TYPE	DESCRIPTION
TL1	Regulatory/Legal	Environment tax policy based on consumption
TL2	Regulatory/Legal	Legal framework
TL3	Regulatory/Legal	Regulatory standards
TL4	Planning&Implementation	Smart City reference framework
TL5	Planning&Implementation	Cisco Smart City framework
TL6	Planning&Implementation	Smart city model
TL7	Planning&Implementation	Smart city Master Plan
TL8	Planning&Implementation	Living labs
TL9	Operations-Hardware	Intelligent wired and wireless networks
TL10	Operations-Hardware	Cisco Service Grids
TL11	Operations-Hardware	Ubiquitous devices
TL12	Operations-Software	Business and personal communication system
TL13	Operations-Software	Smart communication system
TL14	Operations-Software	Data and Information Systems
TL15	Operations-Software	Software tools for data communication
TL16	Operations-Software	Virtual Maps
TL17	Operations-Infrastructure	Smart Nation ICT platform
TL18	Operations-Infrastructure	Data Center Park
TL19	Operations-Infrastructure	Singapore Internet Exchange SGIX
TL20	Operations-Infrastructure	Hardware + Software integrated platform
TL21	Operations-Infrastructure	Customer service center
TL22	Governance&Management	Management tools
TL23	Governance&Management	Facebook
TL24	Governance&Management	Twitter
TL25	Governance&Management	Forums
TL26	Governance&Management	Blogs
TL27	Governance&Management	Virtual questionnaires
TL28	Monitoring	Environment impact assessment tool
TL29	Monitoring	Data Analysis and optimization Software
TL30	Monitoring	Command and control center
TL31	Monitoring	National Internet Measurement Infrastructure
TL32	Monitoring	Data and Information Systems
TL33	Monitoring	Key Performance Indicators (KPIs)

Table 30 shows which of the categories of tools defined in Figure 65 are adopted by which of the 21 case studies. As the summary at the bottom of Table 30 highlights, the largest number of case studies adopted Operations (17), followed by Planning and Implementation (8), Monitoring (5), Regulatory and Legal (3) and Governance and Management (2) categories. The table also compares how many categories of tools were adopted by the case studies from developing countries versus developed countries.

Table 30: Case Study Qualitative Analysis, Attribute 7 – Tools per Case Study

ID	CITY	DEVELOPMENT	TOOLS				
			MONITORING	REGULATORY AND LEGAL	PLANNING AND IMPLEMENTATION	OPERATIONS	GOVERNANCE AND MANAGEMENT
ID001	Bangalore	developing			x	x	
ID002	Cyberjaya	developing				x	
ID003	Eko Atlantic City	developing	x			x	
ID004	Konza	developing	x		x	x	
ID005	Petronia	developing					
ID006	Singapore	developed	x			x	
ID007	Ho Chi Minh	developing	x	x		x	x
ID008	Mexico City	developing		x	x	x	
ID009	Montevideo	developing					
ID010	Bogotá	developing					x
ID011	Medellin	developing					
ID012	Curitiba	developing					
ID013	Barcelona	developed				x	
ID014	Skolkovo	developing			x		
ID015	Amsterdam	developed			x		
ID016	Seattle	developed		x			
ID017	New York	developed				x	
ID018	Guadalajara	developing			x		
ID019	Hong Kong	developed					
ID020	Tianjin	developing	x		x		
ID021	Guimarães	developed			x	x	
TOTAL CASES		developing	4	2	6	6	2
		developed	1	1	2	4	0
		All	5	3	8	10	2

According to Figure 66, developing countries include a greater number of case studies than developed countries in all categories of tools: Operations (6 versus 2 case studies); Planning and Implementation (6 versus 2 case studies); Monitoring (4 versus 1 case studies); Regulatory and Legal (2 versus 1 case studies); and Governance and Management (2 versus 0 case studies). From the analysis, Operations, and Planning and Implementation are two main type of tools used in developing countries.

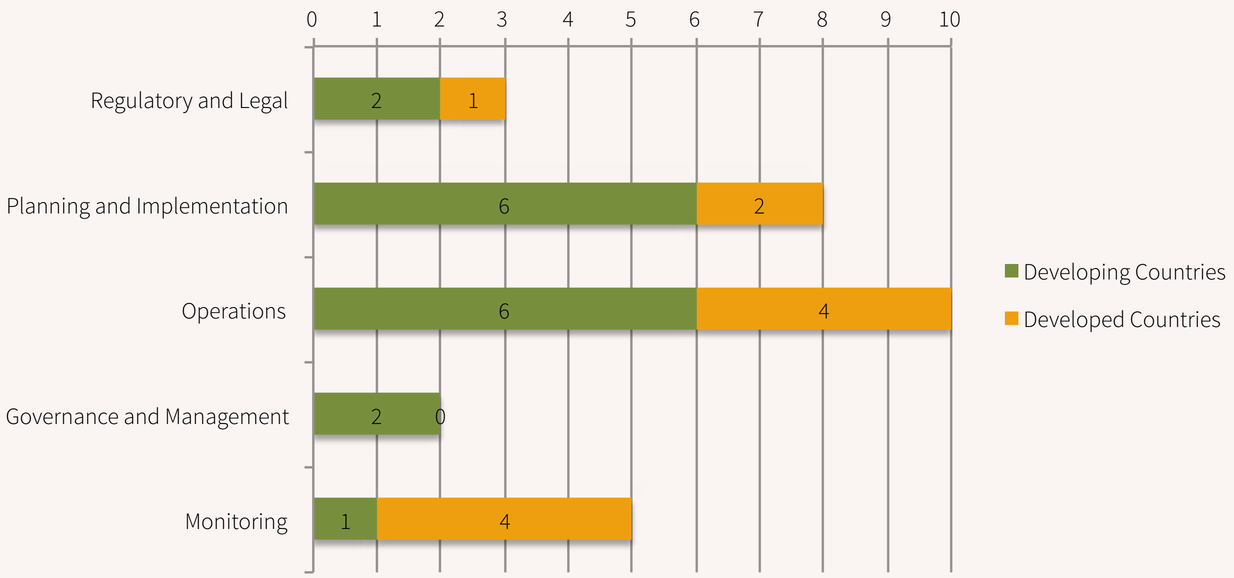

Figure 66: Case Study Qualitative Analysis, Attribute 7 – Tools and Development

Figure 67 also indicates what kind of city models are being adopted by the case studies: 5% apply the Energy City model; 9% Digital City; 5% Knowledge City; 14% Eco City; and 67% apply the Smart City model. No case study applies the Intelligent or Ubiquitous City models.

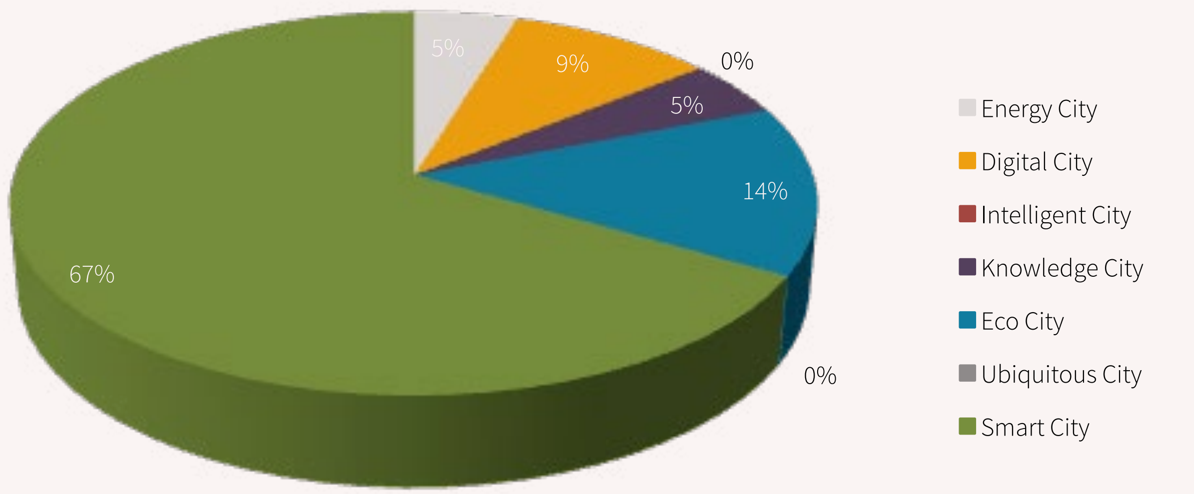

Figure 67: Case Study Qualitative Analysis, Attribute 7 – Smart City Models Used

6.3.8. Attribute 8 – Approaches

The Approaches attribute has two main values: top-down (government-driven) and bottom-up (citizen-driven), as depicted in Figure 68. Table 31 presents which of the 21 case studies adopts which approach. The table also compares the adoption of both approaches by developing versus developed countries.

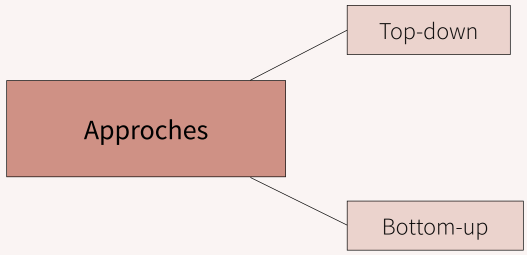

Figure 68: Case Study Qualitative Analysis, Attribute 8 – Approaches Conceptual Map

Table 31: Case Study Qualitative Analysis, Attribute 8 – Approaches per Case Study

ID	CITY	DEVELOPMENT	APPROACHES	
			TOP-DOWN	BOTTOM-UP
ID001	Bangalore	developing	x	
ID002	Cyberjaya	developing	x	
ID003	Eko Atlantic City	developing	x	
ID004	Konza	developing	x	
ID005	Petronia	developing	x	
ID006	Singapore	developed	x	
ID007	Ho Chi Minh	developing	x	
ID008	Mexico City	developing	x	
ID009	Montevideo	developing		x
ID010	Bogotá	developing		x
ID011	Medellin	developing	x	
ID012	Curitiba	developing		x
ID013	Barcelona	developed		x
ID014	Skolkovo	developing	x	
ID015	Amsterdam	developed	x	
ID016	Seattle	developed	x	
ID017	New York	developed	x	
ID018	Guadalajara	developing	x	
ID019	Hong Kong	developed	x	
ID020	Tianjin	developing	x	
ID021	Guimarães	developed	x	
TOTAL CASES		developing	12	3
		developed	6	1
		All	18	4

From the 21 case studies, 4 (19%) adopt the bottom-up approach and 17 (81%) the top-down approach, so the government-driven is dominating. According to Figure 69, developing countries include a greater number of case studies than developed countries for both top-down (12 versus 3 case studies) and bottom-up approaches (3 versus 1 case studies).

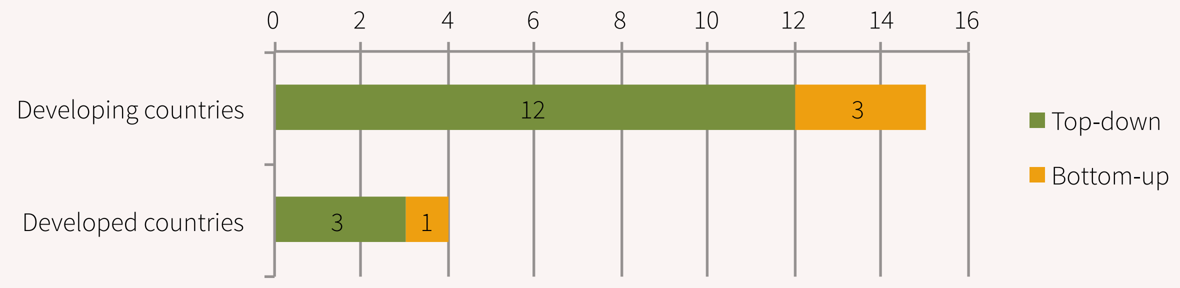

Figure 69: Case Study Qualitative Analysis, Attribute 8 – Approaches and Development

6.3.9. Attribute 9 – Stakeholders

The analysis of the 21 case studies identified 34 stakeholders, divided into stakeholder types (2 types) and stakeholder roles (17 roles) as depicted in Figure 70. The full list of the stakeholder types and roles is presented in Table 32.

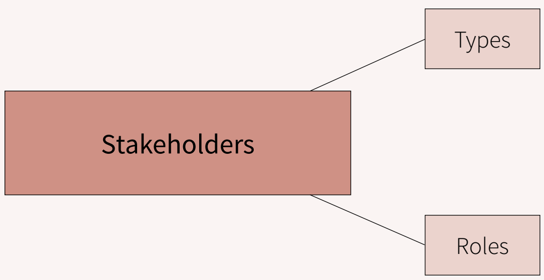

Figure 70: Case Study Qualitative Analysis, Attribute 9 – Stakeholders Conceptual Map

Table 32: Case Study Qualitative Analysis, Attribute 9 – Instances of Stakeholders

ID	TYPE	DESCRIPTION
ST1	Type	Academia
ST2	Type	Citizens
ST3	Type	Government
ST4	Type	NGO
ST5	Type	Industry
ST6	Role	Administrator
ST7	Role	Advisor
ST8	Role	Assistant
ST9	Role	Consultant
ST10	Role	Coordinator
ST11	Role	Coordinator

ST12	Role	Creator
ST13	Role	Designer
ST14	Role	Developer
ST15	Role	Founder
ST16	Role	Funder
ST17	Role	Investor
ST18	Role	Manager
ST19	Role	Participant
ST20	Role	Planner
ST21	Role	Promoter
ST22	Role	Shareholder

Specific stakeholders in all 21 case studies are listed in Table 33 including their types and roles and whether they are funding the initiatives. In total 59 stakeholders are involved in the 21 case studies including 24 government partners, 24 industrial partners, 9 NGOs, and 1 citizen and 1 academic partner in a variety of manager, developer, funder, consultant, advisor, coordinator, assistant, investor, shareholder, designer, creator and other roles.

Table 33: Case Study Qualitative Analysis, Attribute 9 – Case Study Partners

NO	CASE	PARTNER	TYPE	ROLE	FUND
1	ID001	Kanataka Government	Government	Manager	yes
2	ID001	Cisco Systems	Industry	Developer	no
3	ID002	Malaysian Government	Government	Manager	yes
4	ID002	Setia Haruman Sdn. Bhd.	Industry	Developer	no
5	ID003	Lagos State Government	Government	Manager	yes
6	ID003	First Bank of Nigeria	Industry	Funder	yes
7	ID003	Dar Al-Handasah	Industry	Developer	no
8	ID003	Dredging International	Industry	Developer	no
9	ID004	Kenyan Government	Government	Developer	yes
10	ID004	Tetra Tech, Inc.	Industry	Consultant	no
11	ID004	OZ Architecture	Industry	Designer	no
12	ID004	Cisco System, Inc.	Industry	Manager	no
13	ID005	Petronia City Development	Industry	Manager/Developer	yes
14	ID005	AB & David	Industry	Advisor	no
15	ID005	Adjaye Associates	Industry	Designer	no
16	ID005	AECOM	Industry	Developer	no
17	ID006	Smart Nation Programme	Government	Coordinator	yes
18	ID006	IDA	Government	Manager/Developer	no
19	ID007	Vietnamese Government	Government	Coordinator/Manager	yes
20	ID007	KOICA	Government	Assistant	no
21	ID007	Mitsubishi / Toshiba	Industry	Investor	yes

22	ID007	South Korean Lotte	Industry	Investor	yes
23	ID008	Federal Admin. of Mexico	Government	Coordinator/Manager	yes
24	ID009	Martin Rostagnol	NGO	Developer	no
25	ID010	Candidates to Mayor	NGO	Developer	no
26	ID011	Medellin Government	Government	Manager/Developer	yes
27	ID012	URBS	Industry	Manager	yes
28	ID012	Fundação Bamerindus...	NGO	Shareholder	yes
29	ID012	HSBC Seguros (Brasil) S/A	Industry	Shareholder	yes
30	ID012	Banestado S/A...	Industry	Shareholder	yes
31	ID013	SCEA	NGO	Creator	no
32	ID013	CRIC	NGO	Creator	no
33	ID013	Sun Factory	NGO	Creator	no
34	ID013	Environmental/Social Agents	NGO	Coordinator	yes
35	ID013	Citizens	Citizens	Participant	no
36	ID014	Russian Government	Government	Developer	yes
37	ID014	Cisco Systems	Industry	Planner/Developer	no
38	ID014	French Company AREP	Industry	Developer	no
39	ID015	Alliander	Industry	Founder	yes
40	ID015	Amsterdam Economic Board	NGO	Founder	no
41	ID015	ARCADIS	Industry	Founder	yes
42	ID015	Gemeente Amsterdam	Government	Founder	yes
43	ID016	Washington Government	Government	Manager	yes
44	ID016	Seattle City Light	Government	Administrator	no
45	ID017	New York Government	Government	Manager/Developer	yes
46	ID017	Accenture	Industry	Advisor	no
47	ID018	Mexican Federal Government	Government	Designer	yes
48	ID018	Ayuntamiento de Guadalajara	Government	Manager	yes
49	ID018	JALISCO	Government	Manager	yes
50	ID018	Camara de Guadalajara	Government	Manager	yes
51	ID019	Hong Kong Government	Government	Manager	yes
52	ID019	University of Hong Kong	Academia	Advisor	no
53	ID019	French Chamber	NGO	Promotor	no
54	ID019	Dragages HongKong	Industry	Developer	no
55	ID020	SSTEC	Government	Developer	no
56	ID020	Chinese Government	Government	Planner	yes
57	ID020	Singapore Government	Government	Planner	yes
58	ID021	Guimarães Government	Government	Manager	yes
59	ID021	IRRADIARE	Industry	Coordinator	no

6.3.10. Attribute 10 – Governance

The analysis of the 21 case studies identified 7 governance mechanisms organized into vision (1), resources (3), model (1), and principles categories (1), as depicted Figure 71. The full list of the identified governance mechanisms is presented in Table 34.

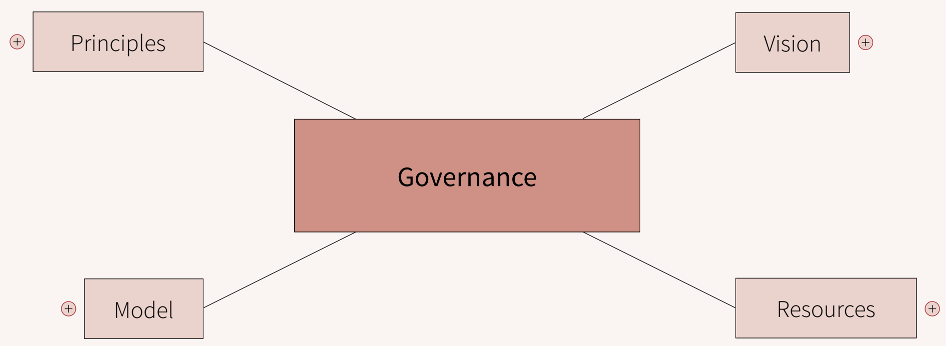

Figure 71: Case Study Qualitative Analysis, Attribute 10 – Governance Conceptual Map

Table 34: Case Study Qualitative Analysis, Attribute 10 – List of Governance Instances

ID	TYPE	DESCRIPTION
GO1	Principles	To involve national, regional and local city officials, develop people ownership and promote business collaboration
GO2	Model	Governance Model should include organization, roles, business processes, rules for decision-making, execution mechanisms, standards for project management, monitoring and evaluation
GO3	Vision	Creating citizen centric, efficient, accountable, transparent, inclusive, creative city and with a sense of safety and security
GO4	Resources	A city command center to host the intelligence and governance of the city
GO5	Resources	Private partners to delegate the responsibility for project management and governance
GO6	Resources	Open Data for providing access to city data by citizens
GO7	Resources	Centralized effective, open and collaborative service delivery

Table 35 shows how different case studies apply the four governance mechanisms: principles, model, vision and resources, and what is the difference in the use of such mechanisms between the case studies run in developing versus developed countries.

Table 35: Case Study Qualitative Analysis, Attribute 10 – Tools per Case Study						
			GOVERNANCE			
ID	CITY	DEVELOPMENT	PRINCIPLES	MODEL	VISION	RESOURCES
ID001	Bangalore	developing			x	
ID002	Cyberjaya	developing				x
ID003	Eko Atlantic City	developing				
ID004	Konza	developing				x
ID005	Petronia	developing				x
ID006	Singapore	developed		x		
ID007	Ho Chi Minh	developing				
ID008	Mexico City	developing				
ID009	Montevideo	developing				
ID010	Bogotá	developing				
ID011	Medellin	developing				
ID012	Curitiba	developing				
ID013	Barcelona	developed				
ID014	Skolkovo	developing				
ID015	Amsterdam	developed				
ID016	Seattle	developed				
ID017	New York	developed				x
ID018	Guadalajara	developing		x		
ID019	Hong Kong	developed	x			
ID020	Tianjin	developing				
ID021	Guimarães	developed				x
TOTAL CASES		developing	0	1	1	3
		developed	1	1	0	2
		All	1	2	1	5

6.3.11. Attribute 11 – Maturity Models

The analysis of the 21 case studies identified 30 maturity features, which were organized into five categories: Approach (5 maturity features); Scope (5 features); Analysis Tools (5 features); Practices (13 features); and Measurement (2 features) as shown in Figure 72. The full list of identified maturity features is presented in Table 36.

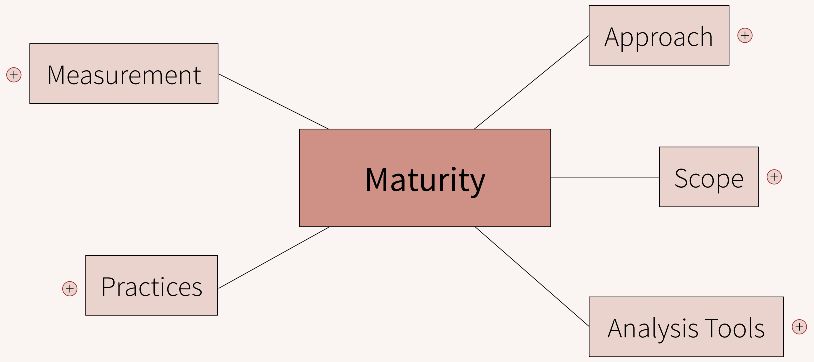

Figure 72: Case Study Qualitative Analysis, Attribute 11 – Maturity Conceptual Map

Table 36: Case Study Qualitative Analysis, Attribute 11 – Maturity Features

ID	TYPE	DESCRIPTION
MA1	Approach	Bottom-up implemented initiatives
MA2	Approach	Citizen-drive agenda
MA3	Approach	Stakeholders' engagement
MA4	Approach	Vision and strategy
MA5	Approach	Implementation plan
MA6	Scope	Delivering a service that is adopted through a long-term period
MA7	Scope	Levels of investments
MA8	Scope	Number of partnerships
MA9	Scope	Addressed domains
MA10	Scope	Drivers - social, economic and environmental
MA11	Analysis Tools	Smart City reference framework
MA12	Analysis Tools	Smart City model
MA13	Analysis Tools	Smart city model deficiencies
MA14	Analysis Tools	Governance model
MA15	Analysis Tools	Service model
MA16	Practices	Good practices related to governance
MA17	Practices	Good practices related to transport
MA18	Practices	Good practices related spatial-planning
MA19	Practices	Good practices related to water-management
MA20	Practices	Good practices related to sewage
MA21	Practices	Good practices related to data and ICT infrastructure
MA22	Practices	Good practices related to electricity
MA23	Practices	Good practices related to mobility
MA24	Practices	Good practices related to environment sustainability
MA25	Practices	Good practices related to social sustainability
MA26	Practices	Good practices related to quality of life
MA27	Practices	Good practice related to citizens participation and engagement

MA28	Practices	Contextualization practices
MA29	Measurement	Key Performance Indicators (KPIs)
MA30	Measurement	Self-assessment tool

Table 37 shows which of maturity categories defined in Figure 72 are adopted by which of the 21 case studies. As the summary at the bottom of Table 37 highlights, the largest number of case studies adopted Analysis Tool (6), followed by Approach (5), Scope (5), Practices (4) and Measurement (4) categories. The table also compares how many categories were adopted by the case studies from developing countries versus developed countries.

Table 37: Case Study Qualitative Analysis, Attribute 11 – Maturity per Case Study

ID	CITY	DEVELOPMENT	MATURITY				
			APPROACH	SCOPE	ANALYSIS TOOL	PRACTICES	MEASUREMENT
ID001	Bangalore	developing			x		
ID002	Cyberjaya	developing			x		
ID003	Eko Atlantic City	developing			x		
ID004	Konza	developing			x		
ID005	Petronia	developing				x	
ID006	Singapore	developed				x	
ID007	Ho Chi Minh	developing					x
ID008	Mexico City	developing					x
ID009	Montevideo	developing	x				
ID010	Bogotá	developing	x				
ID011	Medellin	developing					
ID012	Curitiba	developing		x			
ID013	Barcelona	developed				x	
ID014	Skolkovo	developing		x			
ID015	Amsterdam	developed		x			
ID016	Seattle	developed					x
ID017	New York	developed			x		
ID018	Guadalajara	developing				x	
ID019	Hong Kong	developed	x	x			
ID020	Tianjin	developing	x	x			x
ID021	Guimarães	developed	x		x		
TOTAL CASES		developing	3	3	4	2	3
		developed	2	2	2	2	1
		All	5	5	6	4	4

According to Figure 73, developing countries include a greater number of case studies than developed countries in all categories of maturity: Analysis tool (4 versus 2 case studies), Approach (3 versus 2 case studies), Scope (3 versus 2 case studies) and Measurement (3 versus 1 case studies). The exception is the Practices category with equal numbers of case studies (2 each). From the analysis, Analysis Tools is the most common maturity aid employed by case studies conducted in developing countries.

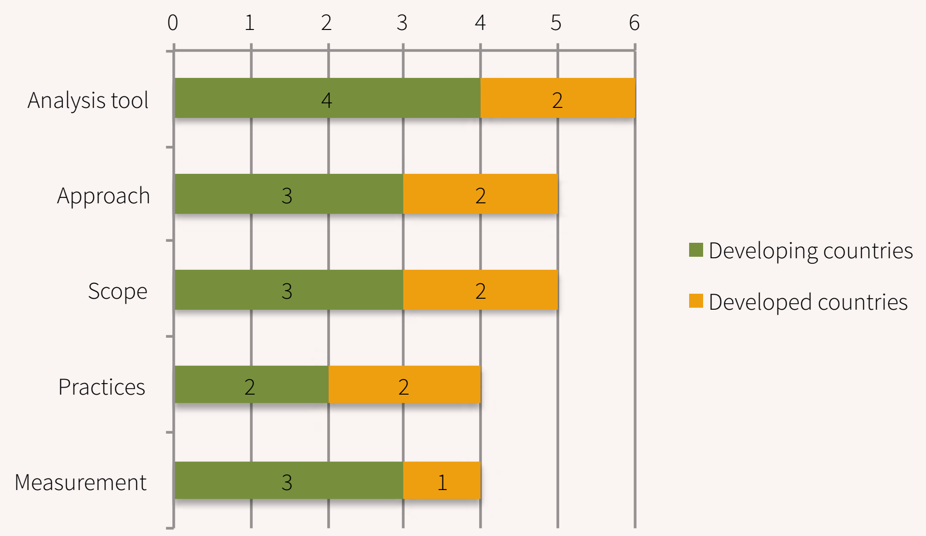

Figure 73: Case Study Qualitative Analysis, Attribute 11 – Maturity and Development

6.3.12. Attribute 12 – Innovations

The analysis of the 21 case studies identified 20 innovations, which were organized into five categories: Technology (2 innovations); Legal/regulatory (2 innovations); Participation (2 innovations); Planning (7 innovations); and Service Delivery (6 innovations) as shown in Figure 74. The full list of identified innovations is presented in Table 38.

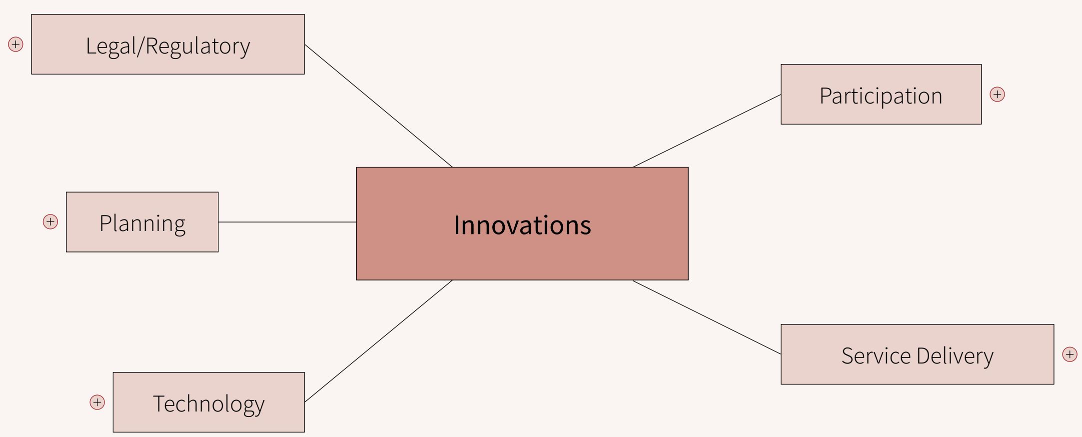

Figure 74: Case Study Qualitative Analysis, Attribute 12 – Innovations Conceptual Map

Table 38: Case Study Qualitative Analysis, Attribute 12 – List of Innovations

ID	TYPE	DESCRIPTION
IN01	Planning	Creating living and working integrated environment for IT experts

IN02	Planning	A city focused on tourism, planed on an artificial island
IN03	Planning	A city focused on energy-based economy
IN04	Planning	A city focused on digital-media innovation
IN05	Planning	Focus groups (consultations and workshops) for city planning
IN06	Planning	A city plan that is practicable, replicable and scalable
IN07	Planning	A city focused on knowledge-innovation based economy
IN08	Planning	A city focused on is historic patrimony as a way to leverage economy
IN09	Service Delivery	Public-private-people partnership eco-system for service delivery
IN10	Service Delivery	Mobile app for buses based on open data by an entrepreneur
IN11	Service Delivery	Escalator facilitating the movement of people in poor neighborhoods
IN12	Service Delivery	Public transport system for the city
IN13	Service Delivery	Living labs for testing new products and services
IN14	Service Delivery	Seamless one-step access to public services through phone NYC 311
IN15	Participation	Promoting citizen participation in policy making for Mayor's agenda
IN16	Participation	Crowdsourcing of a virtual map for environmental issues
IN17	Legal/Regulatory	A credit system for industries based on reducing carbon emissions
IN18	Legal/Regulatory	Legal framework for implementation/adoption of Digital Mexico plan
IN19	Legal/Regulatory	Regulation for the construction of green buildings
IN20	Technology	Network technologies for energy management, collaboration, etc.
IN21	Technology	A city focused on technology-based economy

Table 39 shows which of maturity categories defined in Figure 74 are adopted by which of the 21 case studies. As the summary at the bottom of Table 39 highlights, the largest number of case studies adopted Planning (7), followed by Service Delivery (6), Legal and Regulatory (3), Participation (2) and Technology (1) categories. The table also compares how many categories were adopted by the case studies from developing versus developed countries.

Table 39: Case Study Qualitative Analysis, Attribute 12 – Innovations per Case Study

ID	CITY	DEVELOPMENT	INNOVATIONS				
			PLANNING	SERVICE DELIVERY	PARTICIPATION	LEGAL AND REGULATORY	TECHNOLOGY
ID001	Bangalore	developing					x
ID002	Cyberjaya	developing	x				
ID003	Eko Atlantic City	developing	x				
ID004	Konza	developing		x			
ID005	Petronia	developing	x				

ID006	Singapore	developed					
ID007	Ho Chi Minh	developing				x	
ID008	Mexico City	developing				x	
ID009	Montevideo	developing		x			
ID010	Bogotá	developing			x		
ID011	Medellin	developing		x			
ID012	Curitiba	developing		x			
ID013	Barcelona	developed			x		
ID014	Skolkovo	developing					
ID015	Amsterdam	developed		x			
ID016	Seattle	developed				x	
ID017	New York	developed		x			
ID018	Guadalajara	developing	x				
ID019	Hong Kong	developed	x				
ID020	Tianjin	developing	x				
ID021	Guimarães	developed	x				
TOTAL CASES		developing	5	4	1	2	1
		developed	2	2	1	1	0
		All	7	6	2	3	1

According to Figure 75, developing countries include a greater number of case studies than developed countries in all categories of innovations: Planning (5 versus 2 case studies); Service Delivery (4 versus 2 case studies); Legal and regulatory (2 versus 1 case studies); and Technology (1 versus 0 case study). The exception is the Participation category with equal numbers of case studies (1 each). From the analysis, Planning and Service Delivery are two most common innovations employed by the case studies conducted in developing countries.

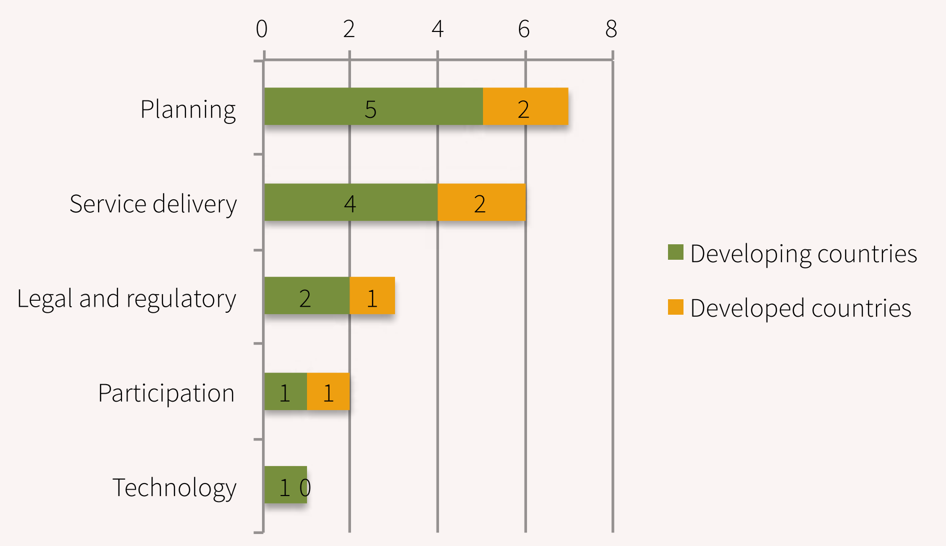

Figure 75: Case Study Qualitative Analysis, Attribute 12 – Innovations and Development

6.3.13. Attribute 13 – Benefits

The analysis of the 21 case studies identified 70 innovations, which were organized into eight categories: Infrastructure for Public Services (11 benefits); Governance & Participation (9 benefits); Economic Growth (10 benefits); Improving Quality of Life (3 benefits); Human Development (7 benefits); Environment Protection (8 benefits); New and Enhanced Digital Services (12 benefits); and City Planning (10 benefits) (see Figure 76). The full list of identified innovations is presented in Table 40.

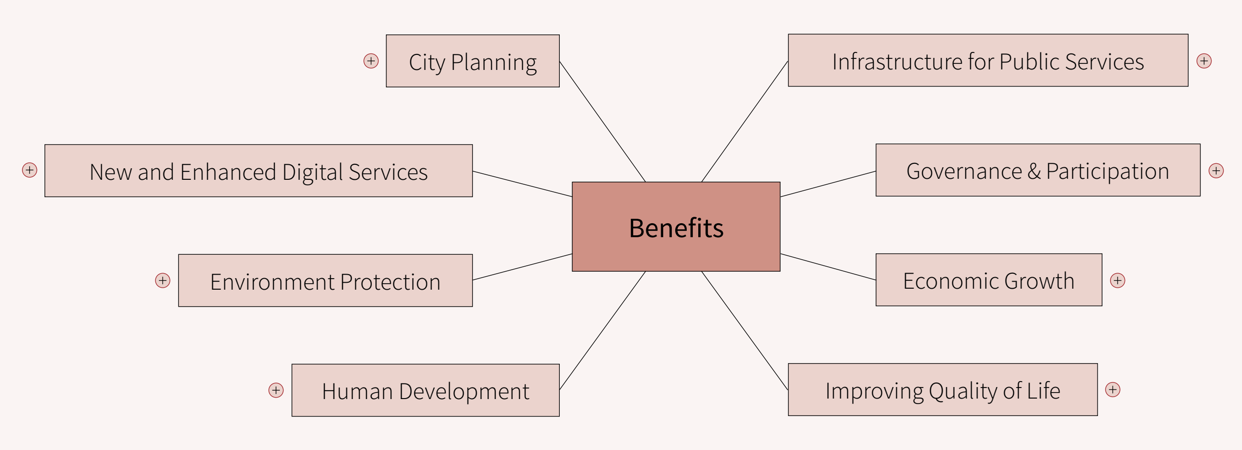

Figure 76: Case Study Qualitative Analysis, Attribute 13 – Benefits Conceptual Map

Table 40: Case Study Qualitative Analysis, Attribute 13 – Instances of Benefits

ID	TYPE	DESCRIPTION
BF01	Infrastructure for Public Services	Facilitating efficient waste management
BF02	Infrastructure for Public Services	Providing energy management system to control consumption
BF03	Infrastructure for Public Services	Providing efficient energy system, providing uninterrupted power supply
BF04	Infrastructure for Public Services	Providing central water management system
BF05	Infrastructure for Public Services	Providing sewage system to keep the city healthy and safe
BF06	Infrastructure for Public Services	Advanced ICT infrastructure, including Wi-Fi coverage for all city
BF07	Infrastructure for Public Services	Providing enhanced communications services
BF08	Infrastructure for Public Services	Providing infrastructure for water, waste, communications, energy, transport
BF09	Infrastructure for Public Services	Providing enhanced transportation services (e.g. parking systems, safe and accessible, bus terminal, master road network)
BF10	Infrastructure for Public Services	Providing enhanced electricity, water, drainage, sewage services
BF11	Infrastructure for Public Services	Improving energy efficiency and reducing water consumption
BF12	Governance & Participation	Fostering citizen participation in public decision-making process
BF13	Governance & Participation	Facilitating access to city data (Open-Data)
BF14	Governance & Participation	Fostering citizens participation in city sustainable development strategy
BF15	Governance & Participation	Engaging stakeholders and building consortiums
BF16	Governance & Participation	Identifying and engaging local investment portfolios
BF17	Governance & Participation	Gaining knowledge about dwellers and people living in neighbourhoods and their needs

BF18	Governance & Participation	Sharing good practices
BF19	Governance & Participation	Improving the use of public resources
BF20	Governance & Participation	Facilitating mission-focus of government agencies work
BF21	Economic Growth	Promoting ICT industry and economic growth
BF22	Economic Growth	Having attractive conditions for business
BF23	Economic Growth	Promoting economic sustainability and growth
BF24	Economic Growth	Promoting business in the energy sector
BF25	Economic Growth	Accelerating the development of new businesses
BF26	Economic Growth	Promoting the city through environment related attractions
BF27	Economic Growth	Promoting economic development through reducing dependency on oil and gas
BF28	Economic Growth	Promoting MICE industry
BF29	Economic Growth	Having creative enterprise clusters
BF30	Economic Growth	Providing new economic opportunities
BF31	Improving Quality of Life	Enhancing public safety and security
BF32	Improving Quality of Life	Enhancing quality of life for citizens
BF33	Improving Quality of Life	Improving the construction of buildings enhancing indoor conditions
BF34	Human Development	Having R&D clusters
BF35	Human Development	Promoting techno-preneurs
BF36	Human Development	Empowering citizens, leveraging on their talent
BF37	Human Development	Promoting Knowledge society based on green related issues
BF38	Human Development	Cultivating good social values related with environment
BF39	Human Development	Creating new educational institutions
BF40	Human Development	Having scientists and engineering workforce
BF41	Environment Protection	Saving energy in buildings
BF42	Environment Protection	Promoting smart buildings saving water and energy
BF43	Environment Protection	Promoting green practices for construction
BF44	Environment Protection	Promoting the production of green products
BF45	Environment Protection	Raising citizens' awareness about improving urban environment
BF46	Environment Protection	Promoting the use of renewable energy
BF47	Environment Protection	Promoting green spaces
BF48	Environment Protection	Reducing carbon emissions
BF49	New and Enhanced Digital Services	Collaborative e-learning tool
BF50	New and Enhanced Digital Services	Having digital ID for citizens
BF51	New and Enhanced Digital Services	Facilitating electronic service delivery
BF52	New and Enhanced Digital Services	Offering one-stop access to public services
BF53	New and Enhanced Digital Services	Facilitating citizens' access to public services
BF54	New and Enhanced Digital Services	Developing services to local business
BF55	New and Enhanced Digital Services	Having real time information about public transport

BF56	New and Enhanced Digital Services	Reducing the burden of emergency calls
BF57	New and Enhanced Digital Services	Eliminating duplicated services
BF58	New and Enhanced Digital Services	Filling gaps in service delivery
BF59	New and Enhanced Digital Services	Improving customers satisfaction
BF60	New and Enhanced Digital Services	Providing better public services
BF61	City Planning	Proactive urban development (e.g. city planning and development, city information and services)
BF62	City Planning	Building residential and commercial areas
BF63	City Planning	Having attractive conditions for businesses
BF64	City Planning	Building sport-facilities (e.g. equestrian polo ground, motor race circuits, gyms)
BF65	City Planning	Planning urban ecology through harmonized eco-systems
BF66	City Planning	Building working spaces (e.g. laboratories, offices)
BF67	City Planning	Monitoring and analyzing energy consumption for city planning
BF68	City Planning	Providing replicable solutions
BF69	City Planning	Regeneration of historical places
BF70	City Planning	Making the city more attractive

Table 41 shows which of the benefit categories defined in Figure 76 are adopted by which of the 21 case studies. As the summary at the bottom of Table 41 highlights, the largest number of case studies adopted Infrastructure (10), followed by Economic Growth (8), Improving Quality of Life (8), City Planning (6), Human Development (6), New and Enhanced Digital Services (6), Government and Participation (5) and Environment Protection (5) categories. The table also compares how many categories were adopted by the case studies from developing versus developed countries.

Table 41: Case Study Qualitative Analysis, Attribute 13 – Benefits per Case Study										
ID	CITY	DEVELOPMENT	BENEFITS							
			CITY PLANNING	INFRASTRUCTURE	GOVERNMENT AND PARTICIPATION	ECONOMIC GROWTH	IMPROVING QUALITY OF LIFE	HUMAN DEVELOP.	ENVIRONMENT PROTECTION	NEW AND ENHANCED DIGITAL SERVICES
ID001	Bangalore	developing		x					x	x
ID002	Cyberjaya	developing		x			x	x	x	x
ID003	Eko Atlantic	developing		x		x	x			
ID004	Konza	developing		x		x				
ID005	Petronia	developing	x	x						
ID006	Singapore	developed			x	x	x			
ID007	Ho Chi Minh	developing	x			x		x	x	
ID008	Mexico City	developing								x
ID009	Montevideo	developing		x	x					
ID010	Bogotá	developing						x		
ID011	Medellin	developing			x		x			
ID012	Curitiba	developing		x			x			
ID013	Barcelona	developed				x			x	x
ID014	Skolkovo	developing	x			x		x		
ID015	Amsterdam	developed	x		x					
ID016	Seattle	developed		x			x			
ID017	New York	developed			x		x			x
ID018	Guadalajara	developing	x			x				
ID019	Hong Kong	developed	x	x			x			x
ID020	Tianjin	developing		x				x	x	
ID021	Guimarães	developed				x		x		
TOTAL CASES		developing	4	8	2	5	4	5	4	3
		developed	2	2	3	3	4	1	1	3
		All	6	10	5	8	8	6	5	6

According to Figure 77, developing countries include a greater number of case studies than developed countries in: Infrastructure (8 versus 2 case studies); Economic Growth (5 versus 2 case studies); City Planning (4 versus 2 case studies); Human Development (5 versus 1 case study); and Environmental Protection (4 versus 1 case studies). In addition, there are an equal number of case studies in: Improved Quality of Life (4 case studies each); New and Enhanced Digital Services (3 case studies each); and developed countries include more case studies than developing countries in Government and Participation (3 versus 2 case studies). From the analysis, Infrastructure, Economic Growth and Human Development are the most common benefits realized by the case studies conducted in developing countries.

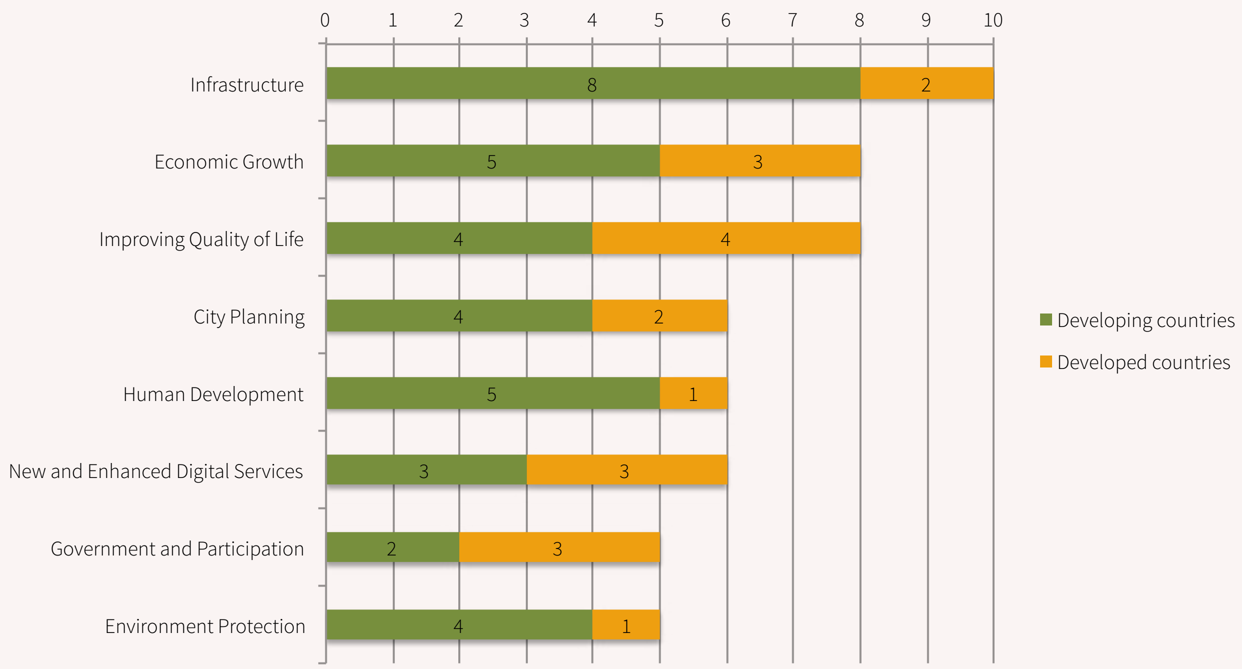

Figure 77: Case Study Qualitative Analysis, Attribute 13 – Benefits and Development

7. Conceptual Framework

Based on the research literature review (Section 4), policy literature review (Section 5) and the case study development (Section 6), this section presents our vision and conceptual framework for Smart City for Sustainable Development. The vision is presented in Section 7.1 and the conceptual framework in Section 7.2.

7.1. Vision

Given the urbanization trends discussed in Section 2, the continuing fast changes affecting urban development and urban life, and specific context of each city, the development of a Smart City is a problem that is continuously changing and with no unique solution to fit all requirements. As defined in (Rittel and Webber 1973), we can see the development of a Smart City as a wicked problem, i.e. a policy problem that cannot be definitely described, defined by a pluralistic society where there is no undisputable public good, with no objective definition of equity, with no policies that are meaningfully correct or false, and without optimal solutions to the social problems. Table 42 illustrates ten distinguished features of wicked problems (Rittel and Webber 1973) applied to Smart City development.

Table 42: Conceptual Framework – Smart City Development as a Wicked Problem
1. There is no definitive formulation of a Smart City.
2. The development of Smart City has no mechanism to decide when the "smart" status has been achieved (no stopping rule).
3. Smart City solutions are not true or false, but good or bad depending on the context.
4. There is no immediate and no ultimate test of Smart City solution.
5. Every Smart City initiative is a "one-shot operation", counting significantly to development.
6. A Smart City does not have an enumerable set of potential solutions or a well-described process to implement them.
7. Every Smart City is essentially unique.
8. A problem addressed by a Smart City initiative can be considered to be a symptom of another problem.
9. The existence of a discrepancy when developing a Smart City initiative can be explained in numerous ways. The choice of explanation determines the nature of the Smart City solution.
10. The social planner has no right to be wrong, i.e. those responsible for Smart City initiatives will be liable for the impact that the Smart City initiative will have in the residents' lives.

Conceiving the development of a Smart City as a wicked problem motivates us to propose a vision for Smart City development focusing on the process itself and not on the ultimate status. Due to the nature of the problem, the value of the Smart City concept does not refer to the final status of city development to be achieved sometime in the short, mid or long-term future, but to the continuous transformative process of making a city smarter.

Our proposed vision of Smart City for sustainable development is formulated in Table 43.

Table 43: Conceptual Framework – A Vision for Smart City Development
Smart City development refers to the continuous transformative process of building different types of capacities, e.g. infrastructural, technical, human, institutional, and others in a city that contribute to improving quality of life of its residents, to achieving socio-economic development, and to protecting natural resources; conducted based on the stakeholder engagement and collaboration.

7.2. Framework

The definition of the conceptual framework on Smart City for Sustainable Development relies on five major inputs:

1. The vision of Smart City for Sustainable Development presented in Table 43;
2. The findings of the research literature review, policy literature review and case study development, as presented in Sections 4, 5 and 6 respectively;
3. One major principle to achieve sustainable development – policy coherence (UN OWG 2015);
4. The six dimensions of Smart Cities as proposed in (Giffinger et al. 2010); and
5. The basic principle of monitoring and measuring any transformative process.

The conceptual framework is depicted in Figure 78 and explained in the following sections.

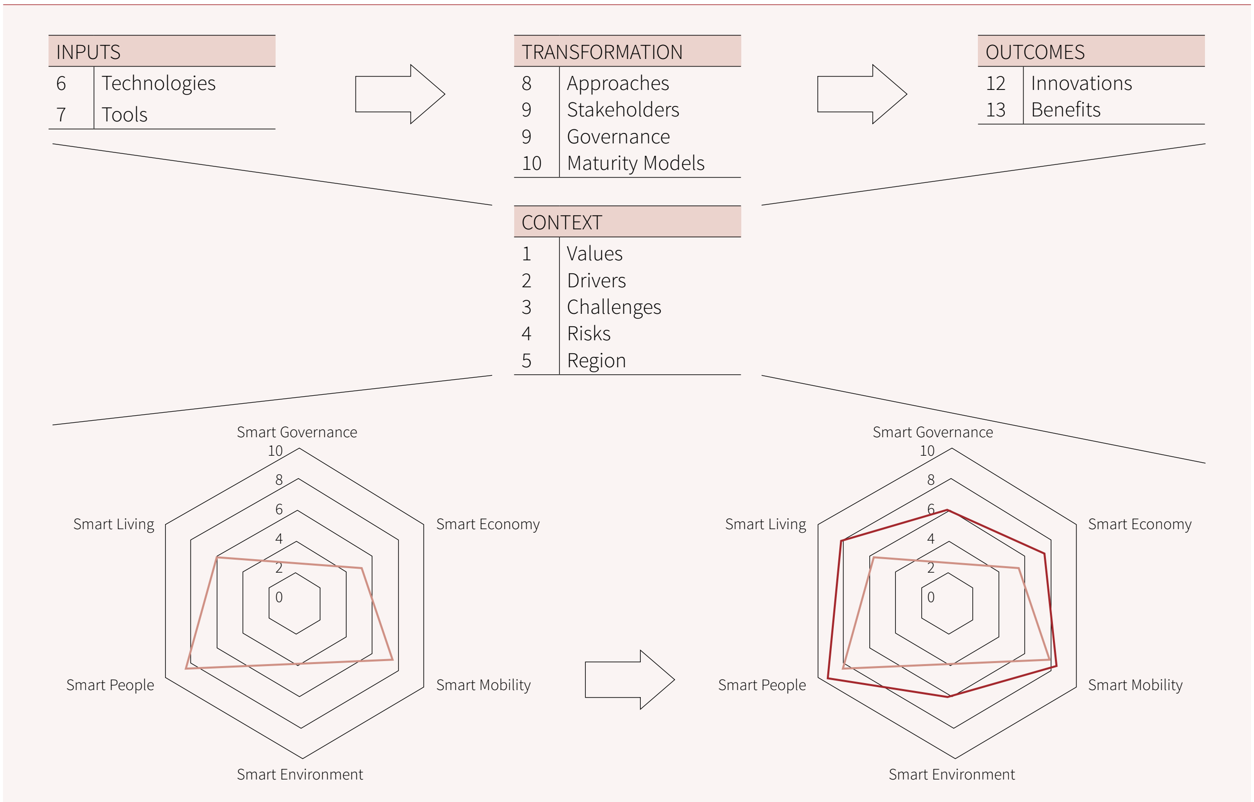

Figure 78: Conceptual Framework – Smart City for Sustainable Development

7.3. Element 1 – Context

The context refers to specific features of the local environment (the city) that must be considered for the development of a Smart City. It includes different attributes that will affect the choices for planning and implementing Smart City initiatives, such as: values, drivers, challenges, risks and regions. Each of them is explained and illustrated below based on the findings from the research and policy literature reviews and case study development.

7.3.1. Attribute 1 – Values

The values driving Smart City initiatives can be of different nature related to: 1) the city itself; 2) sustainable development, including socio-economic development and environmental protection; and 3) the governance process adopted for conducting such initiatives. Following such considerations, values are classified into five categories: 1) City; 2) Economic Development; 3) Social Development; 4) Environment Protection; and 5) Governance. The values are defined below.

City Values – The set of agreed values to be used in defining the vision of a Smart City, for example: social, vibrant, livable, clean, healthy, safe, responsive, resilient, promoting proximity between people's accommodation and working environments, and sustainable.

Economic Values – Smart City initiatives promoting economic development should be driven by clear values, for example to thrive in job creation and financial growth, and to develop the entrepreneurial culture.

Social Values – Smart city initiatives represent opportunities to cultivate social values by empowering social activities. Example social values include: development of human capital through Smart City e-learning platforms, talent development, equity and fairness, social inclusion, institutionalizing civic values e.g. sense of belonging, and civic discipline.

Environment-related Values – Any Smart City initiative needs to ensure that environmental resources are protected for future generations. Example environment-related values include: green areas protection, and commitment to reducing CO2 emissions.

Governance Values – Since the development of Smart City initiatives highly depends on the governance approach, having clear governance value makes a difference. Example governance values include: giving voice to citizens for planning and building their city, developing citizen engagement and participation in community-related issues, consensus building for inclusive decisions, bringing citizens together around collective goals, transparency, public scrutiny, and strengthening government-citizen collaboration.

7.3.2. Attribute 2 – Drivers

Drivers for developing Smart City initiatives depend on: 1) the age of the city; 2) development focus of the initiatives; and 3) city dimensions to be improved. These are defined below.

City Age Drivers – There are two different drivers for Smart City initiatives based on the city history. In the case of old cities, Smart City initiatives can be seen as a mechanism for regeneration of urban areas. In the case of new cities, Smart City initiatives are a useful approach for conducting a rational city planning following a local strategy aligned with regional and national urbanization and development strategies.

Development Drivers – Depending on the development focus of the Smart City initiatives example drivers include: leveraging on the deployment of ICT for city development, leveraging on human capital, emphasizing on business-led development, attracting investments, and promoting the development of a given sector, like e.g. renewable energy, creative industries or high-tech industries.

City Dimension Drivers – Ultimately, the drivers may depend on the city dimensions to be improved by Smart City initiatives. Such drivers could be: economic, social, environment, mobility, living and governance.

7.3.3. Attribute 3 – Challenges

Smart City initiatives need to overcome or provide solutions, as defined below, to different types of challenges: 1) economic; 2) social; 3) environmental; 4) technical; 5) service delivery; 6) financial; 7) governance; and 8) institutional.

Economic Challenges – Examples include improving local competitiveness against regional and international markets, diversifying economic activities, obtaining funding for Smart City initiatives, overcoming spatial inequalities in productivity and income, overcoming pressures to the resource base due to growth of urban populations, reducing capital and operational expenditures, facing budget cuts affecting local governments, and controlling efforts driven by wild capitalism.

Social Challenges – Examples include ensuring equity and fairness, reinforcement of social and territorial cohesion, ensuring social inclusion, addressing political and ethnic tensions, increasing burden on adult social care, ensuring the availability of services for different communities in the city, and leveraging human capital.

Environmental Challenges – Examples include protecting natural resources and green areas, reducing emissions generated by transport systems, reducing energy consumption or using renewable energy, addressing environmental degradation caused by urbanization, adopting green practices, reducing dependency on gas and oil, reducing air pollution, and addressing the scarcity of natural resources.

Technical Challenges – Examples include deployment of integrated city infrastructure and service platforms, solving machine-to-machine communication, ensuring system and data security, managing spectrum utilization, defining and ensuring the adoption of interoperability standards, provision of analytical methods needed to integrate qualitative and quantitative data from heterogeneous sources, making optimal use of interconnected information for improving efficiency of city operations, optimizing the use of limited resources, having the appropriate technology at the right time, contextualizing a solution or a good practice to the local conditions, and producing and delivering scalable solutions.

Service Delivery Challenges – Examples include increased demand for energy, water and sanitation; increased waste generation and shortfalls in municipal budgets to collect and proper dispose of waste; increased pressure on housing and transport systems; improving public safety by reducing crime and emergency response time; reducing traffic congestions; ensuring the construction of comfortable city facilities and buildings; improving quality of services by delivering innovative services and streamlining and tailoring services to address citizens' needs; ensuring the right levels of security and resilience across delivery models; updating new releases of public services without major disruptions to ongoing service delivery; ensuring 24*7 service availability; and ensuring customers' satisfaction by maintaining data and information up to date.

Financial Challenges – Examples include ensuring availability of financial resources; addressing possible lack of capacity for attracting investors; ensuring the construction of cost effective buildings and facilities; reducing operational costs; and ensuring long-term sustainability of the delivered solutions.

Governance Challenges – Examples include engaging private sector in testing solutions, adopting decisions and proposals made by citizens; defining the proper role for private sector actor interventions – defining where, when, how they should be engaged; attracting talent; enabling distributed implementation and execution by different stakeholders supported by central coordination; and establishing a governance committee with broad representation of government levels and societal sectors.

Institutional Challenges – Examples include ensuring departmental coordination and alignment, overcoming bureaucracy in government agencies, attracting qualified IT professionals and relevant IT players, and having qualified human resources for service delivery.

7.3.4. Attribute 4 – Risks

Smart city initiative face various types of risks, such as: 1) economic; 2) social; 3) environmental; 4) technical; 5) financial; and 6) strategical. Each category is described below.

Economic Risks – Examples include promoting economic development based only on energy resources, developing an economy highly influenced by external factors, developing an economy only focusing on or highly dependent on ICT knowledge or the ICT industry, and low take up of delivered solutions due to high fees to access the services/products.

Social Risks – Due to different nature of social risks, we propose a further classification and refinement. The categories and examples include: 1) *Social Divide* – deepening social polarization and gentrification, deepening digital divide, and increasing disparities for accessing health services and knowledge; 2) *Social Exclusion* – rising citizens' feeling of exclusion due to restrict access to connectivity and services, like controlled access to exclusive places; increasing social exclusion of local citizens due to efforts to attract qualified foreigners; neglecting citizens' opinions due to political interests; and not addressing special needs of vulnerable groups; 3) *Adoption* – resistance to change resulting in low adoption or take up of new services, low adaptation and flexibility capacity for adopting new solutions, rising citizens' concerns on privacy and security due to pervasive deployment of ICT; 4) *Impact* – disregarding legal, social and ethical impact of ICT, negative experiences of citizens and visitors due to high surveillance implemented by Smart City initiatives, developing a society driven by individuals instead of communities' values due to the lack of common history and culture of dwellers, promoting economic development disregarding social concerns; and 5) *Cultural* – facing lack of transparency of government authorities, lack of trust among stakeholders, and low reliability among partners.

Environmental Risks – Examples include having a negative environmental impact of the Smart City initiative, not achieving the reduction of carbon footprint to comply with the Kyoto protocol, and promoting economic activities disregarding environmental concerns.

Technical Risks – Examples include technology-centered vision, facing cyber-attacks, limited capacity for satisfying service transport demand, lack of urban related research, generalizing results without proper contextualization, lack of alignment among project components, developing decoupled city infrastructure components, lack of open discussions on the use of ICTs, lack of awareness about the duality of introducing new technologies, lack of capacity for disaster management, difficulties for adopting integrated approaches, information failures, lack of trust in data privacy and system integrity

Financial Risks – Examples include lack of financial resources to afford the cost of the initiative, not being able to attract investors, not being able to efficiently collect service fees, and overcoming market failures.

Strategical Risks – Examples include initiatives driven by a restrictive vision focused only on technology deployment; initiatives driven by personal objectives, ideological and political interests; avoiding the manipulation of biased information that could distort reality; lack of communication between city planners and citizens; lack of integration among policies, ICT deployment and city plans; lack of careful readiness assessment of costs, ecological concerns and political implications; possible inter-organizational tension and conflicts; coordination failure, inability of cities to gain first mover advantage; fear of lock-in by vendors.

7.3.5. Attribute 5 – Region

A city is located in a geographical region, which may comprise more cities sharing similar problems and opportunities. Strengthening collaboration of cities in the same region and pursuing common goals can facilitate the development of Smart City initiatives. Example factors to be considered at the regional level include: 1) finding solutions to cities in the region by scaling up problems to be solved at the regional level, e.g. delivering common cloud services for all cities in the region; 2) defining common vision for cities in the region, e.g. pursuing regeneration of a whole region; and 3) seeking common benefits from individual contributions and collaboration, e.g. pursuing sustainable development of the region based on coordinated efforts conducted by individual cities.

When developing Smart Cities within a regional umbrella, specific concerns should be addressed, including: leveraging urban-interdependencies and the regional context; considering the city organizational culture, priorities, objectives and strategic vision; considering the relative position of the city in the region and global urban networks; preserving the urban heritage as identity; and framing initiatives into regional objectives according to the local settings.

Finally, problems are different from regions to regions. Differences rely on industrial and political history, culture, topology, geography, as well as on regional, national and international policies. Therefore, knowledge transferring of Smart City solutions at the regional level needs to be carefully analyzed based on the regional context.

7.4. Element 2 – Inputs

Inputs refer to specific elements that the transformation process of a Smart City initiative can use. Two input attributes are technologies and tools. Each attribute is explained and illustrated below based on the findings from the research and policy review and case study development.

7.4.1. Attribute 6 – Technologies

Technologies constitute a primary element to develop Smart Cities. Indeed, the Smart City concept is a new approach for urban development focused on the use of ICTs to improve quality of life of city dwellers. However, improving a city infrastructure used to provide basic services, i.e. electricity, water or sanitation, requires not only ICTs, but other technologies as well. We classify Smart City technologies into: ICTs, Hardware Tools, Software Tools, New ICT Approaches, and Other Technologies. Each category is described below.

ICTs – Examples include telecommunication and data networks; data centers; telecommunication networks; IPv6; wireless networks; computer networks; green ICTs for agriculture, forestry and biology; mobile technologies; vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technologies; vehicle prioritization technologies; ubiquitous networks; satellite TV; mobile technologies; RFID; pervasive services technologies; and multimedia technologies, surveillance and security technologies.

Hardware Tools – Examples include mobile devices, smart phones, sensors, and TV cameras.

Software Tools – Examples include ICT collaborative tools, video streaming tools, e-learning tools, web tools, databases, virtual maps, mobile apps, operation management tools, open source software, geographical information systems (GIS) and geo-informatics, electronic commerce tools, Customer Relationships Management (CRM) systems, and Automated-Fare-Collection (AFC) systems.

New ICT Approaches – Examples include open data, big data, cloud computing and cloud services, reality virtualization, data mining, data analytics, cyber-security, Internet of Things, and cloud computing and cloud services.

Other Technologies – Examples include those related to energy like solar, wind, and tidal; smart power grids; green materials and construction technologies; mechanics for transportation systems; green chemicals; and technologies for waste treatment.

7.4.2. Attribute 7 – Tools

Tools play a relevant role in Smart City development. In particular, tools contribute to: better planning and design of Smart City systems; better understanding the design strategies; predicting behavior of Smart City solutions; analyzing how a city works; improving services using context aware information; and assessing how user-driven open innovation econ-systems behave and could be organized. Based on the various roles, different types of tools are applied to Smart City development, such as: Regulatory; Planning; Operational; Governance and Management; and Monitoring tools. Each category is illustrated below.

Regulatory Tools – Examples include standards, e.g. ISO Standards for City Indicators; legal frameworks, and domain-specific policies, like an environmental tax policy based on consumption.

Planning Tools – Examples include Smart City reference frameworks, e.g. Cisco Smart City Framework; Smart City models, e.g. IBM Smarter City Actionable Business Architecture, and Municipal Reference Model; and Smart City master plans.

Operational Tools – The category includes all types of tools used for daily delivery of city services. We further classify operational tools into Hardware, Software and Infrastructure. Examples for each subcategories include the following: 1) Hardware – intelligent wired and wireless networks, Cisco service grids, ubiquitous devices, and sensor networks; 2) Software – business and personal communication systems, smart communication systems, data and information systems, software tools for data communication, virtual maps, simulation tools, modeling tools, virtual reality tools, and Innovation Technology (IvT); and 3) Infrastructure – smart nation ICT platform, e.g. Singapore Internet Exchange (SGIX), data center park, customer service center, command and control center, test beds, and living labs.

Governance and Management Tools – Examples include social media including Facebook, Twitter, forums and blogs; tools for project and program management, and tools for gathering stakeholders' opinions, like online surveys.

Monitoring Tools – Examples include environmental impact assessment tool; data analysis and optimization software; national Internet measurement infrastructure; key performance indicators, e.g. ITU Key Performance Indicators in Smart Sustainable Cities, UN Habitat City Prosperity Index; and assessment tools, e.g. Microsoft CityNext Assessment.

7.5. Element 3 – Transformation

Transformation refers to the process of building different types of capacities for the city to become smarter and for improving quality of life of its citizens. Specific studied attributes relevant to the transformation process include: 1) approaches; 2) stakeholders; 3) governance; and 4) maturity models. Each of them is explained and illustrated below based on the findings from the research and policy review and analyses of case studies.

7.5.1. Attribute 8 – Approaches

Two broad approaches to Smart City development are top-down and bottom-up. A top-down approach presents the following characteristics: 1) the strategy is developed by government; 2) government provides incentives and possibly funding; 3) government publicizes the initiatives to help their adoption; and 4) usually this type of approaches provides a more technical vision. A bottom-up approach exhibits other characteristics, such as: 1) city processes are carried out based on contributions from various actors, including creative communities, research institutions and the private sector; 2) market oriented public-private-partnership are created by partner initiatives; and 3) initiatives are originated and conducted through citizen engagement.

Other approaches include: 1) an integrated approach to providing a platform for businesses to develop required solutions; and 2) a citizen-centric approach, meaning that citizens' needs are placed at the forefront, and service providers share information to provide coherent and seamless services, rather than operating in multiple service silos.

7.5.2. Attribute 9 – Stakeholders

Stakeholder engagement is a crucial requirement for the success of Smart City development. Four major stakeholders' attributes to consider include: 1) Types; 2) Roles; 3) Activities; and 4) Partnerships. Each of them is illustrated below.

Stakeholder's Types – Examples include citizens, municipal or local government, city officials, private enterprises, civil society, Internet Service Providers (ISPs), water providers, energy providers, foreigner experts and consultants, non-government organizations (NGOs), community leaders, and international organizations.

Stakeholders' Roles – Examples include 1) Project Owner – mostly played by the municipal government; 2) Project Performers – enterprises contributing to project implementation; 3) Strategic Partners – companies providing some type of basic services, e.g. ISPs, energy and water providers; 4) Individual Contributors – citizens actively participating in designing Smart City solutions through various mechanisms such as crowdsourcing, gamification, social networks and social media; 5) Civil Society – playing a key role in implementing participatory processes for urban governance; and 6) Customers – comprising the recipient of Smart City solutions, including citizens, visitors, private companies, etc.

Stakeholders' Activities – Stakeholders are required to conduct three major activities: 1) interact; 2) network; and 3) collaborate.

Stakeholders' Partnerships – Public-Private Partnerships (PPPs) or Public-Private-People-Partnerships (PPPPs) are essential for Smart City development. PPPs open the provision of public services to private companies, while the public authority remains responsible for enabling the policy environment and regulatory framework that protects the rights and interests of citizens and investors. PPPs and PPPPs enable governments to leverage on private sector and citizens' capacities to innovate, invent and bring in efficient solutions.

7.5.3. Attribute 10 – Governance

Governance is another major attribute for the successful completion of Smart City initiatives. Six attributes are included to define governance: 1) Requirements; 2) Principles; 3) Vision; 4) Resource Management; 5) Models; and 6) Government Role. Each of them is presented and illustrated below.

Governance Requirements – The main governance requirements for Smart City development includes: 1) creation of a central agency responsible for coordination of initiatives likely implemented by different partners; 2) centralized e-Governance with a comprehensive strategy to enable effective and optimized coordination and control; 3) strong leadership; 4) well designed governance model; 5) defining clear governance principles; 6) adopting resilient processes; 7) defining performance measures of city services; and 8) enabling continuous improvements. In addition, there should be a clear distinction between responsibilities of central and local governments. While the former are responsible for promoting labor mobility, developing infrastructure and removing impediments for internal trade; the latter are responsible for improving quality of life of their residents and minimize their costs of living. Local governments are also responsible for making cities “work better” by improving the provision of local public services, such as sewage and public transport. In particular in developing countries, local governments also need to ensure the needed urban policy interventions for limiting urbanization to already crowded cities.

Governance Principles – Examples include efficiency, effectiveness, transparency, collaborative, open, accountability, good governance, and governance by incentives rather than governance by enforcement. In addition, another governance principle refers to stakeholder engagement, e.g. involving national, regional and local civil officials, people ownership, and business collaboration. Finally, governance through be enriched through public participation made possible by social media and by making government information available in the public domain.

Governance Vision – A vision for Smart City development should be produced through participatory governance mechanisms. An example vision, “creating citizen-centric, efficient, accountable, transparent, inclusive, creative city, with a sense of safety and security”.

Resource Management – Governance approaches should be considered to manage four types of resources: 1) Infrastructure, e.g. establishing a city command center to host the intelligence and governance of the city; 2) Partners – a possible approach is delegating the responsibility for the management of the project to a private partner; 3) Data – opening access to government data; and 4) Services – implementing a centralized effective, open and collaborative approach to service delivery.

Governance Model – A governance model should include the definition of: 1) an organizational model identifying partners, their roles and responsibilities; 2) rules for decision-making; 3) execution mechanisms; 4) business processes; and 5) procedures for project management, monitoring and evaluation.

Government Role – As a major stakeholder, local government plays important roles including: 1) making choices where to locate infrastructure investments and where to improve services; 2) ensuring efficient and transparent policy making for managing urbanization; 3) enacting policies to increase energy efficiency and to promote cleaner energy sources for electricity generation, buildings and urban transport; 4) adopting multi-sectoral policies for sustainable, green urban growth; 5) encouraging compact and efficient cities through land and housing regulations as well as through market-based incentives; 6) developing strong institutions and partnerships among the public sector, private sector and civil society; 7) building capacity of local actors; 8) prioritizing investments in core systems, such as transport, education, public safety and health; 9) identifying the political agenda and ensuring project alignment; 10) conducting a self-assessment including a review of the government’s situation; and 11) implementing a quality management system.

7.5.4. Attribute 11 – Maturity Models

Measuring and monitoring enables to assess the progress towards the achievement of goals and provide feedback in case the project needs alignment or reviews. Maturity models provide a reference model for measuring progress. Other instruments are also applied and proved to be useful. Indeed, the various attributes of a Smart City need to be identified and can be used as part of the metrics and reference model for defining the smartness of a city. For this study, the Maturity Models attribute defines possible features related to measuring and monitoring Smart City initiatives. We describe the attribute based on the following perspectives: 1) Aim; 2) Tools; and 3) Indicators. Each is presented and illustrated below.

Aim – Several tools are used for measuring and monitoring. The aim of applying such tools include: to measure the readiness of a city for implementing a given initiative; to measure the degree of smartness of the city on a given area; to measure the level of maturity of service delivery or policy area of a city compared to other cities; to help choose the priority domains for a city; and to assist in developing the guidelines for Smart City implementation.

Tools – Several tools exists for measuring and monitoring Smart City initiatives, some commercial and others developed by governments:

- IBM provides a set of tools that includes: 1) Smarter City Assessment, which enables collecting information about operating city systems; 2) Smarter City Maturity Model, which assesses and helps build a roadmap for the city; 3) Smarter City Actionable Business Architecture, which defines relationships between different city domains; and 4) Municipal Reference Model, which describes a set of city concepts, tools, and offered services.
- The Government of Scotland and Scottish Cities Alliance defined and use the Smart Cities Maturity Model – comprising six maturity stages: level 1 or Ad-hoc, level 2 or Opportunistic, level 3 or Purposeful and Repeatable, level 4 or Operationalized, and level 5 or Optimized; and five dimensions: 1) Strategic Intent; 2) Data; 3) Technology; 4) Governance and Service Delivery Models; and 5) Citizens and Business Engagement. They also defined and use the Self-Assessment Tool that comprises three stages to be completed through a questionnaire.
- The Government of India provides the Smart City Model, which comprises four stages: The model comprises four stages: 1) Access; 2) Efficiency; 3) Behavior; and 4) System Focus. It also defines application domains including transport, spatial planning, storm water drainage, water supply, solid waste management, sewage, electricity, telephone, and Wi-Fi.
- ITU defines Key Performance Indicators (KPIs) for smart sustainable cities. The proposed indicators focuses on a set of ICT related indicators for smart sustainable cities but does not cover all KPIs of cities contained in the ISO standard 37120. The indicators are grouped into the following categories: 1) Information and Communication Technology; 2) Environmental Sustainability; 3) Productivity; 4) Quality of Life; 5) Equity and Social Inclusion; and 6) Physical Infrastructure.
- The World Bank proposes to measure the "urban metabolism" of a city, analyzing how cities consume, produce and transform materials and energy. They highlight that all cities should begin measuring material flows and other environmental and social data, and that all cities need a credible and standardized "urban resilience index".
- A number of good practices implemented or adopted by other cities can also serve as a relevant bench-learning tools. Relevant good practices are related to governance, transport, spatial-planning, water-management, sewage, data and ICT infrastructure, electricity, mobility, environment sustainability, social sustainability, quality of life, citizens participation and engagement, as well as contextualization practices.

Indicators – Examples include the number of stakeholders engaged, number of bottom-up implemented initiatives, levels of investments, number of established partnerships, and number of city domains addressed and improved.

7.6. Element 4 – Outcomes

Outcomes refer to results produced by the Smart City transformation processes. Outcomes include two attributes: innovations and benefits. Each of them is explained below based on the findings from the research and policy literature reviews and case study development.

7.6.1. Attribute 12 – Innovations

ICT and new technologies have the ability to provide environment-friendly and economically viable innovative solutions for cities. Innovations were studied through three perspectives: 1) Strategies; 2) Processes; and 3) Mechanisms. Each of the perspectives is presented and illustrated below.

Innovation Strategies – Examples include: 1) outsourcing services using outcomes-based contracts; 2) providing solutions for service integration, both back office and more increasingly front office services; 3) providing online service delivery; 4) releasing data to enable new services to be developed and citizens to make informed decisions; 5) reducing demand on given services, e.g. promoting independent living facilitating elderly people to live longer with less support from the state; and 6) promoting user-driven innovation.

Innovation Processes – Innovation can be supported during all processes of Smart City development. Innovation processes are classified and illustrated as follows:

- *Innovation in Planning* – organizing focus groups, consultations and workshops for city planning; and defining a city plan that is practicable, replicable and scalable. In addition, the results of planning should also be innovative; for example: planning the creation of living and working integrated environment for IT professionals; a planned city focused on tourism, planed in an artificial island created by reclaimed land; a planned city focused on energy-based economy; a planned city focused on digital-media innovation; a planned city focused on knowledge-innovation based economy to reduce the dependence on oil and gas; a planned city focused on its historic patrimony as a way to leverage its economy.
- *Innovation in Regulations* – examples include a credit system for industries based on reducing carbon emissions; a legal framework for implementation and adoption of a digital plan; and regulation for the construction of green buildings.
- *Innovation in Service Delivery* – examples include establishing an eco-system for public-private-people partnership for service delivery; a mobile app for tracking the trajectory of public buses developed by an entrepreneur based on open data; an electric escalator, part of public transport system, facilitating the move of people from-to poor neighborhoods in the city; public transport system for the city; living labs for testing new products and services; and seamless one-stop access to public services through phone a unique, easy to remember phone number.
- *Innovation in Citizen Participation* – examples include promoting citizen participation in policy making for defining mayors' agendas, and crowdsourcing of a virtual map for raising awareness about environmental issues, or unsafe neighborhoods in the city.

Innovation Mechanisms – Examples include test beds, living labs, crowdsourcing, and user communities. Innovation is facilitated by providing access to government data through open data initiatives. Another important mechanism is an open eco-system, which needs to be deployed, organized and monitored. Usually, open eco-systems serve as test beds and living labs, and can be fostered through incentives and policies.

7.6.2. Attribute 13 – Benefits

Major benefits of Smart City development is to foster economic and sustainable development of cities while protecting the environment and improving the quality of life of its inhabitants. Benefits of successful Smart City initiatives can be achieved at different levels. We classify benefits into: 1) Economic; 2) Environmental; 3) Human Development; 4) Quality of Life; 5) Basic Services; 6) Digital Services; and 7) Governance. Each category is presented and explained below.

Economic Benefits – Examples include promoting the ICT industry and economic growth, having attractive conditions for businesses, promoting economic sustainability and growth, promoting business in the energy sector, accelerating the development of new businesses, promoting the city through environment related attractions, promoting economic development through reducing dependency on oil and gas, promoting the Meetings, Incentives, Conferencing and Exhibitions (MICE) industry, increasing employment opportunities, having creative enterprise clusters, accelerating new business start-ups, engaging and leveraging Small Medium Enterprises (SME)s community, and providing new economic opportunities.

Environmental Benefits – Examples include saving energy in buildings, promoting smart buildings saving water and energy, promoting green practices for construction, promoting the production of green products, raising citizens' awareness about improving urban environment, promoting the use of renewable energy, promoting green spaces, reducing carbon emissions, and planning urban ecology through harmonized eco-systems.

Human Capital Benefits – Examples include having Research & Development clusters, promoting techno-preneurs, empowering citizens leveraging on their talent, promoting Knowledge Society based on green related issues, cultivating good social values related with the environment, creating new educational institutions, providing lifelong learning opportunities, and having and anchoring scientists and engineering workforce.

Quality of Life Benefits – Examples include enhancing public safety and security, improving traffic conditions, reducing time required for moving from home to office, improving health conditions of dwellers due by accessing to water and sanitation services, regenerating historical places, making the city more attractive and livable, improving social equality, better community connectivity, binding disperse and separate communities, accelerating access to safety solutions, and improving the construction of buildings by enhancing indoor conditions.

Basic Services-related Benefits – Examples include facilitating efficient waste management; providing energy management system to control consumption; providing efficient energy system; providing uninterrupted power supply providing central water management system; providing sewage system to keep the city healthy and safe; providing infrastructure for water, waste, communications, energy, and transport; building new residential and commercial areas; building working spaces, e.g. laboratories, offices; building sport-facilities, e.g. equestrian polo ground, motor race circuits, gyms, etc.; delivering resilient public services; and offering decent living conditions to every resident, e.g. good quality and affordable housing, access to cost efficient physical, social and institutional infrastructures such as adequate and quality water supply, sanitation, 24*7 electric supply, clean air, quality education, cost efficient health care, dependable security, entertainment, sports, and fast and efficient mobility.

Digital Services-related Benefits – Examples include facilitating citizen access to public services like water and sanitation; having real time information about public services, e.g. transport; reducing the burden of emergency calls; eliminating duplicated services; filling gaps in service delivery; developing services to local business; providing enhanced communications services; deploying advanced ICT infrastructure including Wi-Fi coverage the whole city; facilitating electronic service delivery by having digital ID for citizens and offering one-stop access to public services; improving customers' satisfaction, and providing access to collaborative e-learning tool contributing to build human capital.

Governance Benefits – Examples include fostering citizen participation in public decision-making process, improving transparency, facilitating access to city data through open-data initiatives, fostering citizen participation in city sustainable development strategy, engaging stakeholders and building consortiums, enhancing collaboration with non-government actors, identifying and engaging local investment portfolios, gaining knowledge about dwellers and people living in neighborhoods and their needs, sharing good practices with other cities, making more efficient use of public resources, facilitating government agencies to focus on mission-related work, facilitating proactive urban development through city planning and provision of city information and services, monitoring and analyzing energy consumption for city planning, promoting innovations, and providing replicable solutions.

7.7. Element 5 – Measurement

Two types of measurement exercises are mandatory, one at the initial stage and one at the final stage of Smart City transformation. The aim of the former is to assess the context, a kind of readiness assessment, analyzing the status of the city capacity at the various dimensions – economic, people, environment, mobility, governance and living. The aim of the latter is to measure the developed capacities. Any Smart City initiative should aim at improving capacities of more than one type.

8. Policy Recommendations

Based on the project findings from research literature review (Section 4), policy literature review (Section 5), case study development (Section 6), and the proposed conceptual framework for Smart Cities for Sustainable Development (Section 7), this section provides some policy recommendations for building Smart Cities for Sustainable Development. Following the structure of the conceptual framework, we provide recommendations related to the context (Section 8.1), inputs (Section 8.2), transformation (Section 8.3) and outcomes (Section 8.3). Relying on the vision of a Smart City as a transformation process, detailed recommendations are provided for transformation attributes.

8.1. Context

Policy recommendations related to Context include:

- Prepare a solid foundation for Smart City initiatives, by gaining a deep understanding of the local context through readiness assessment. Possible assessment areas include:
    - priority domains, values, drivers, challenges, and risks;
    - city stakeholders and their level of preparedness for Smart City initiatives, including their ICT-related capabilities;
    - current legal and regulatory framework for Smart City initiatives;
    - funding mechanisms and opportunities, as well as local investment portfolios;
    - current ICT infrastructure deployed in the city and in government agencies, and their capabilities, including the support they provide for delivering other public services such as energy, water, transport, among others;
    - current public services in given priority domains and possible areas for improvement.
- Design the readiness assessment exercise with support of a multi-disciplinary team of qualified professionals including representatives from government, academia, industry and civil society; maximize the number of represented stakeholders in terms of their number, sectors and representations.
- In collaboration with local academics, supported by international experts, if needed, identify a set of Smart City good practices to be used by the city for bench-learning purposes. Good practices should include cases from two types of cities: 1) cities with similar conditions as the local context and 2) cities that are excelling in a given domain of interest to the local context.

- Identify a set of cities at the regional, national and international level, with whom the city can promote collaboration on Smart City development.
- If the city is part of a regional network, dedicate efforts to asses if other cities in the network decided to embrace similar initiatives and analyze how to leverage such initiatives through city-level collaboration.
- Initiate sensitization campaigns and educate the society on issues relevant to smart sustainable cities, including energy consumption and the use of renewable energy sources, carbon footprints, green areas, water consumption, and waste management. Dedicate special efforts to raising awareness and educate children at schooling age.
- Leverage on the changes introduced by Smart City development, as an opportunity to instill civic values in the society.

8.2. Inputs

Policy recommendations related to Inputs include:

- Based on the local conditions, conduct a feasibility study to understand the type of ICTs capabilities, and capabilities of other technologies used to deliver basic services, like energy, water, sanitation, construction, etc.; that can be adopted in the city.
- Review good practices implemented in other cities of interest, including tools and technologies applied in the targeted domain.
- Based on the existing regulatory and legal framework surveyed as part of context readiness assessment, identify and address regulatory and legal gaps and weaknesses; in particular, related to the following areas:
  - public-private partnerships;
  - administrative simplification, with special focus on businesses and SMEs;
  - whole-of-government approach;
  - open access to government data and information;
  - protection of intellectual property rights; and
  - privacy and security, among others.
- In collaboration with academia, the private sector and international organizations, design and implement initiatives dedicated to building institutional capacity of the local government as a whole and of selected government agencies. Among others, possible areas for institutional capacity building include the adoption of:
  - social media and procedures and tools for citizen participation;
  - open data initiatives;
  - big data and data analytics;
  - standards for Smart City initiatives;
  - approaches for performance measurement;
  - methodologies and tools for program and project management.
- When identifying tools and technologies to be adopted, prioritize those that: 1) are based on open standards, 2) fit within the overall architecture, 3) fulfill with interoperability requirements, and 4) avoid future lock-in scenarios from vendors.
- Engage academia and the private sector in efforts in localizing and adopting new tools in the local context.

- When adopting new technical tools, ensure that users can effectively and efficiently use them. If needed, design trainings on such tools and hire qualified experts that can support the adoption and usage of the tools on operational scenarios.
- Define human-capacity building programs for each group of stakeholders based on: 1) new trends to be adopted in the city, 2) the target audience, and 3) training needs assessment conducted among the target audience.
- In collaboration with academia, the private sector and international organizations, design and implement initiatives dedicated to building human capacity among government officials at all levels, particularly policy makers, project leaders, and public managers. Possible areas for human-capacity building include:
  - leadership;
  - strategic planning;
  - stakeholder engagement and citizen participation;
  - innovation;
  - cultural change;
  - critical thinking and systems thinking;
  - scenario planning models, and urban simulation methods and tools;
  - data analytics and evidence-based policy making;
  - program and project management;
  - open data; and
  - cloud computing.
- In collaboration with academia, the private sector and international organizations, design and implement initiatives dedicated to building human capacity for the relevant external stakeholders, including:
  - entrepreneurs – for them to be able to contribute to Smart City development, and
  - citizens – for them to be able to consume and benefit from the produced results.
- In collaboration with academia, private sector and civil society, dedicate special efforts to embed a lifelong learning culture in the society supported by the provisioning of collaborative e-learning platforms. Learning offers should focus on knowledge relevant to the local culture and economy and available in local language.

8.3. Transformation

Policy recommendations related to Transformation are further classified into: 1) Approaches; 2) Stakeholders; 3) Governance; and 4) Maturity Models. Each of them presented in the following sections.

8.3.1. Approaches

Policy recommendations related to Approaches include:

- Smart City development requires a combined approach. The foundations and the “big picture” for Smart City development need to follow a top-down, government-led approach, while specific initiatives in a given domain can be successfully conducted following a bottom-up approach.

- It is government responsibility to provide an innovation eco-system and stimulate bottom-up innovative solutions for Smart City development.
- There are no off-the-shelf solutions ready for adoption for Smart City development. Every solution or good practice needs to be localized to the context.
- Be aware that a city does not become smarter just by implementing technical solutions; other factors, like social, cultural, economic and environmental are to be addressed and considered.
- Knowing that any change in the physical transformation of a city produces changes in the economy and the society, systems thinking is needed to plan, design and assess Smart City initiatives.
- Demystify the complexity of problems and lack of resources as mechanisms to avoid changes, since not all city problems are complex or require a lot of resources for solving them.
- Break down the lack of action and just define what is needed, since the risk of doing nothing is bigger than the risk of doing things wrong.
- Keep in mind that it is impossible to reach a scenario with all warrantees for innovations not to fail, and make the decision to start, i.e. to innovate, the first requirement is to start.

As part of approaches, some policy recommendations related to strategy include:

- In consultation with city stakeholders, define a clear vision of what the city wants for its future and define a strategy and a well-defined plan for implementing the vision.
- Ensure that the vision is not merely focusing on technology, but highlights improvements in other city dimensions, like environment, quality of life and people, among others.
- Define a Smart City strategy thinking in the dual commitment to short- and long-term results. The strategy should not be focused on simply the next achievable steps.
- Before preparing the strategy, dedicate sufficient amount of resources to rigorous identify and learn from global good practices to be able to identify advanced solutions.
- Ensure that the Smart City strategy is aligned with overall strategy of the city and region.
- Ensure that the defined city plan is doable and scalable.
- Avoid the following scenarios when defining Smart City initiatives:
  - initiatives driven by a restrictive vision focused only on technology deployment;
  - initiatives driven by personal objectives;
  - initiatives driven by ideologies and political interests;
  - initiatives shall pay special attention to ensure city and service resilience; and
  - initiatives are highly coherent and integrated with city policies and plans.
- Prepare a detailed business plan including considerations about the long term sustainability of the delivered solutions.
- Use analytical tools to compare the value of potentially unrelated projects to decide which ones to prioritize.
- Be aware that the planning process will need continuous reviews, mainly taking into account citizens' feedback.
- As part of capacity-building efforts, create policies and environments for attracting talents, qualified professionals and IT players.
- Ensure effective communication between city planners and citizens.

8.3.2. Stakeholders

Policy recommendations related to Stakeholders include:

- Take into account that inclusion and participation are important targets for successful Smart City programs.
- Ensure stakeholders' acceptance, commitment and contribution to Smart City initiatives through active mechanisms of stakeholder engagement. Provide mechanisms to facilitate their interactions, networking and collaboration to leverage on private sector and citizens' capacities to innovate, invent and bring in efficient solutions.
- Create a sense of citizens' ownership and commitment by empowering them through active participation. Organize and maintain open discussions with and awareness campaigns for citizens
- Define mechanisms for strengthening the capacity of academia in conducting multi-disciplinary Smart City research for them to be able to play to major roles: 1) think tank for government, and 2) capacity-builder for other stakeholders.
- Create and rely on teams of highly-qualified and motivated professionals with deep commitment to deliver public value.
- Identify and leverage on inspiring leaders ('city champions').
- Accelerate, through policies and incentives, new business start-ups, engage and leverage on Small Medium Enterprises (SME)s community, providing new economic opportunities for businesses.
- Empower citizens leveraging on their talent and promote techno-preneurs.

8.3.3. Governance

Policy recommendations related to Governance include:

- Be aware that governance is responsible for:
  - defining a comprehensive strategy to enable effective and optimized coordination and control;
  - ensuring strong leadership;
  - defining a well-designed governance model with clear rules for decision-making;
  - defining clear governance principles;
  - adopting procedures for project management, monitoring and evaluation; and
  - adopting resilient processes, solutions and services.
- In consultation with stakeholders, define clear governance principles from the earliest stage of the project and ensure that major stakeholders responsible for governance adhere to and practice such principles.
- Define clear roles and responsibilities for each type of stakeholder. In particular define:
  - roles and responsibilities for the project owner, project performers, partners, contributors, the civil society, and service recipients; and
  - the proper role for private sector actors' interventions – define where, when and how they will collaborate; consider engaging the private sector in testing solutions.
- Raise awareness about the role and responsibilities of the local government. Example responsibilities of local government include:
  - reinventing public service with a moral purpose – a new agenda for delivering public value;

  - developing strong institutions and partnerships among the public sector, private sector and civil society, which can act as "learning systems" – systems able to bring their own transformation to better perform in a continuous changing context;
  - building capacity of local actors;
  - enabling the policy environment and regulatory framework that: a) enables contributions from the private sector, including SMEs, through public-private-partnerships (PPPs) and b) protects the rights and interests of citizens and investors;
  - designing regulations and incentives encouraging compact and efficient cities through land and housing regulations as well as through market-based incentives;
  - ensuring efficient and transparent policy making for managing urbanization, including enacting policies to increase energy efficiency, to promote cleaner energy sources and sustainable and green urban growth;
  - initiating the planning process of Smart City initiatives and inviting the private sector to help implementing the plan and citizens to provide feedback;
  - making decisions related to the future; being aware that if the government is unable or unwilling to make decisions, the market will speculate and will try to take advantage; decisions include making choices where to locate infrastructure investments and where to improve services;
  - prioritizing investments in core systems, such as transport, education, public safety and health;
  - identifying the political agenda and ensuring project alignment;
  - conducting a self-assessment including a review of the government's situation; and
  - adopting a quality management system.
- Facilitate distributed execution implemented by different stakeholders, supported by a central coordination. Establish a governance committee, with broad representation of government levels and societal sectors to ensure coordination and alignment of activities performed by internal and external stakeholders.
- Promote trust among stakeholders by promoting transparency, accountability and adherence to the pre-defined governance values.
- Have a clear distinction between responsibilities of central and local governments. While the former are responsible for developing infrastructure and removing impediments for internal trade; the latter are responsible for improving quality of life of their residents, minimize their costs of living, and making their cities "work better" by improving the provision of local public services.
- Enrich governance through public participation made possible by social media and by making government data and information available in the public domain.
- Open access to government data by implementing open government data initiatives, as mechanisms for increasing participation, and leveraging innovation through the co-creation of public services.
- Implement a centralized effective, open and collaborative approach to service delivery.

8.3.4. Maturity Models

Policy recommendations related to Maturity Models include:

- Measure the "urban metabolism" of a city, analyzing how cities consume, produce and transform materials and energy.
- Define and adopt a performance measurement system, including the definition of key performance indicators for Smart City programs and projects.

- Conduct efforts to make timely progress in more than one city dimension; it is counter-productive to advance one characteristic while neglecting to advance others. However, not all characteristics need to have the same level of maturity; stakeholders need to define and agree on the priority areas.
- Adopt a maturity model for Smart City initiatives. Be aware that a leapfrogging approach is counterproductive and not recommended – it is not possible to advance more than one step in each stage, due to managerial, technological and financial capacity and due to the counter-productive effect (will put excessive pressure on many city systems and functions that normal day-to-day operations may be at risk).
- Enable a culture and mechanisms for enabling continuous improvements.
- Establish mechanisms to measure innovations, and if deployed the innovation eco-system.

8.4. Outcomes

Policy recommendations related to Outcomes include:

- Establish, organize and deploy an open innovation eco-system enabling public-private-people partnership (PPPP) for service delivery.
- Promote innovation mechanisms, like hackathons for developing mobile apps based on open government data, crowdsourcing of ideas, public sector innovation awards, awards for citizens' contributions, etc.
- In collaboration with external stakeholders, establish living labs for the co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and testing of technological instruments and artefacts in real life use cases.
- Promote user-driven innovation processes, enabled by providing access to government data through open data initiatives.
- Deliver innovative solutions in relevant service areas, e.g. promoting independent living, facilitating elderly people to live longer with less support from the state.
- Deliver e-learning platforms, as mechanisms for building human capital and fostering innovation.
- Contribute to establishing and developing Research & Development (R&D) clusters, ensuring scientists and engineering workforce, and providing mechanisms to anchoring qualified experts.
- Promote Knowledge Society based on green-related issues, cultivating good social values related with the environment, sustainable practices, green IT practices, creating new educational institutions, and providing lifelong learning opportunities.
- Implement a knowledge sharing platform to promote Smart City good practices of the city and the region. Relevant good practices are related to: governance, transport, spatial-planning, water-management, sewage, electricity, mobility, environment sustainability, social sustainability, quality of life, citizens' participation and engagement, data and ICT infrastructure, and contextualization practices.
- Create synergies for deploying city technology infrastructure and building city institutional capacity, and create structures on early stages providing a common platform to host services, e.g. middleware for Smart City services, and information exchange platforms.

9. Research Agenda

The findings obtained from the research literature review (Section 4), policy literature review (Section 5) and case study development (Section 6) enable identifying relevant problems to Smart City development, which are synthesized in this section to prepare the basis for defining a research agenda.

The rest of this section is structured as follows. First, we briefly discuss research problem attributes (Section 8.1). Second, we identify sources of research problems relevant to Smart City development (Section 8.2). Third, we propose a framework for defining a research agenda for smart sustainable cities and illustrate it with some examples (Section 8.3).

9.1. Attributes of Research Problems

When defining a research problem, several considerations should be made, like interest, magnitude, level of expertise, relevance, and availability of data, among others (Kumar 2005). Based on our understanding, we briefly introduce below four main attributes to be considered for a good research problem for the Smart City domain:

1. *Relevance* – a research problem should be compelling, in the sense that is relevant to a large community, can add to the existing body of knowledge, addresses current gaps or is useful for solving a concrete demand or for policy formulation.
2. *Multiple Dimensions* – a research problem should not be formulated based on solving a dichotomy, i.e. type of problems accepting a yes/no answer but on problems that can be explored following different dimensions or viewpoints.
3. *Researchable* – researchers should be able to analyze and measure concepts related to the problem, i.e. there should be primary or secondary data available to study the problem.
4. *Focused* – the problem to be investigated should contribute to the transformation process of building capacity for Smart City development.

9.2. Sources of Research Problems

To define source of research problems we use the “four Ps” approach applied by the humanities – People, Problems, Programs and Phenomena. Based on this approach (Kumar 2005), its adaptation for the Smart City domain is explained below and depicted in Table 44.

A research study has two major aspects: 1) the study population (Smart City population), and 2) the subject area (Smart City subject area). The former comprises the People, while the latter is about Problems, Programs and Phenomena. In the Smart City domain, People include all possible city stakeholders. Problems comprise city issues, needs, city service profiles, governance issues, and urban models, among others. Programs refer to city interventions like new governance and city structures, services and products delivered, outcomes, attributes, capacities, and service consumers and producers, among others. Phenomena comprises the cause and effect relationships in Smart City initiatives, or the study of given circumstances related to a Smart City initiative.

Table 44: Research Agenda – Aspects of Smart City Research Problems

Smart City Aspect	About	Study of	Relevance
Smart City Population	People	City stakeholders, including individuals, organizations, communities	○ Sources of primary data ○ Researchers collect information from or about them
Smart City Subject Area	Problem	City issues, needs, city service profiles, governance issues, urban models	○ Smart city-related subject about which researchers need to collect information to find answers to the research problem
	Program	New governance and city structures, service and products delivered, outcomes, attributes, capacities, service consumers and providers	
	Phenomenon	Cause and effect relationships in Smart City initiatives, the study of given circumstances related to a Smart City initiative	

To prepare the ground for defining relevant Smart City research problems, the following four sections present instances of People, Problems, Programs and Phenomena, respectively.

9.2.1. People

Table 45 presents some examples of city stakeholders, all of them instances of People.

Table 45: Research Agenda – Smart City Research Problems – People

ID	DESCRIPTION	ID	DESCRIPTION
1	Government	11	Private sector companies
2	City major	12	Professional associations
3	Public managers	13	Entrepreneurs
4	Government IT leaders	14	Education institutions
5	Project managers	15	Researchers
6	Government employees	16	NGOs
7	Consultants	17	Community leaders
8	Service recipients	18	Other cities in the region
9	Service providers	19	Regional bodies
10	Citizens	20	National government

9.2.2. Problems

Table 46 presents some examples of city problems.

Table 46: Research Agenda – Smart City Research Problems – Problems	
ID	DESCRIPTION
1	Assessing readiness in city service provision
2	Assessing city infrastructure readiness
3	Assessing city stakeholders' readiness
4	Assessing regulatory and legal framework for smart sustainable city
5	Assessing local context for Smart City development - values, drives, challenges, risks
6	Assessing citizens' needs
7	Defining a governance model
8	Defining a Smart City strategy
9	Prioritizing domains
10	Prioritizing services
11	Learning from good practices
12	Defining urbanization models
13	Preparing participatory budgets
14	Managing city infrastructural changes
15	Managing cultural change
16	Improving communication between city planners and citizens
17	Improving city transport
18	Promoting efficient use of energy
19	Protecting green areas
20	Reducing time for city commuting
21	Managing and reducing waste
22	Recycling products
23	Reducing CO2 emissions
24	Protecting cultural heritage
25	Improving safety
26	Facilitating evidence-based policy making through data analytics
27	Promoting participatory governance
28	Increasing citizen participation
29	Building trust between government and citizens
30	Improving government accountability
31	Improving private companies' accountability on green practices
32	Providing access to government data
33	Defining PPP models
34	Defining PPPP models

35	Innovating in public service delivery
36	Facilitating co-production of public services
37	Building entrepreneur's skills
38	Defining mechanisms to promote social innovation
39	Facilitating user-driven innovation processes
40	Building human capital
41	Documenting good Smart City practices
42	Facilitating knowledge sharing
43	Resolving interoperability
44	Facilitating collaboration between government agencies
45	Facilitating government-business collaboration
46	Facilitating government-academia collaboration
47	Simplifying government administrative procedures
48	Implementing whole-of-government approach
49	Enabling service integration
50	Improving service response time

9.2.3. Programs

Table 47 presents some examples of city programs.

Table 47: Research Agenda – Smart City Research Problems – Programs

ID	DESCRIPTION
1	Governance structure
2	Coordination center and central coordination
3	Customers center for one stop access to public services
4	City network
5	National strategy for Smart City development
6	Green IT policies
7	Stakeholder engagement
8	Social media used by government
9	Wi-Fi areas
10	City ICT Infrastructure
11	Energy, green IT, waste and environmental policies
12	Waste prevention and recycling
13	Green areas
14	Buildings with green energy
15	Renewable energy sources
16	Regeneration of historical places
17	GIS-services for tourism

18	GIS-services for cultural heritage
19	ICT-based services for elderly
20	ICT-based services for disabled people
21	ICT-based services for transport
22	Quality of services and quality management system
23	Resilient services
24	Secure services
25	Surveillance services
26	Emergency response services
27	Customers' satisfaction
28	Electronic payment service
29	IT platform for service integration
30	Middleware for the rapid development of EPS
31	Cloud services
32	City Reference Architecture
33	City Standards
34	Mobile apps
35	e-Learning platforms
36	Living labs
37	Entrepreneurs
38	Innovation eco-system
39	Online courses
40	Life-long learning culture
41	Systems thinking
42	Knowledge sharing platform
43	Smart city model
44	Smart city maturity model
45	Performance measures
46	Key performance indicators
47	Open data
48	Big data
49	Deployment of TV cameras
50	Deployment of sensors

9.2.4. Phenomena

Table 48 presents some examples of city phenomena.

Table 48: Research Agenda – Smart City Research Problems – Phenomena

ID	DESCRIPTION
1	Social inclusion
2	Economic development
3	Environmental impact
4	Digital divide
5	Social polarization and gentrification
6	Livable city
7	Consumption of new public services
8	Improvements in urban metabolism
9	Citizen's welfare
10	Quality of life improvements
11	Human development
12	City resilience
13	Community feelings
14	City internationalization
15	Return of investments for private companies
16	Regional collaboration
17	Regional development
18	Employment
19	Smart living
20	Citizen's awareness on sustainability
21	Good governance
22	Sustainable practices adopted by citizens
23	Sustainable practices adopted by businesses
24	Sustainable practices adopted by government
25	Sustainable practices adopted by the city
26	Feeling of citizens' ownership
27	Empowered citizens
28	Responsive government employees
29	Creation of public value
30	Local actors' capacity

9.3. Research Agenda

The main purpose of defining a research agenda for one domain is to define the scope of research problems to be studied in this domain. To fulfill such purpose, the following two sections present a framework for defining research problems for Smart Sustainable Cities (Section 9.3.1) and examples of such research problems (Section 9.3.2).

9.3.1. Framework

After identifying major aspects of Smart City research problems, we would like to recall the discussion of the Smart City background domains presented in Section 3. Based on such discussion, we conceive the problem-solution space for Smart Cities for Sustainable Development, or Smart Sustainable Cities, at the intersection of three domains – Urbanization, Sustainability and Digitization, as depicted in Figure 79.

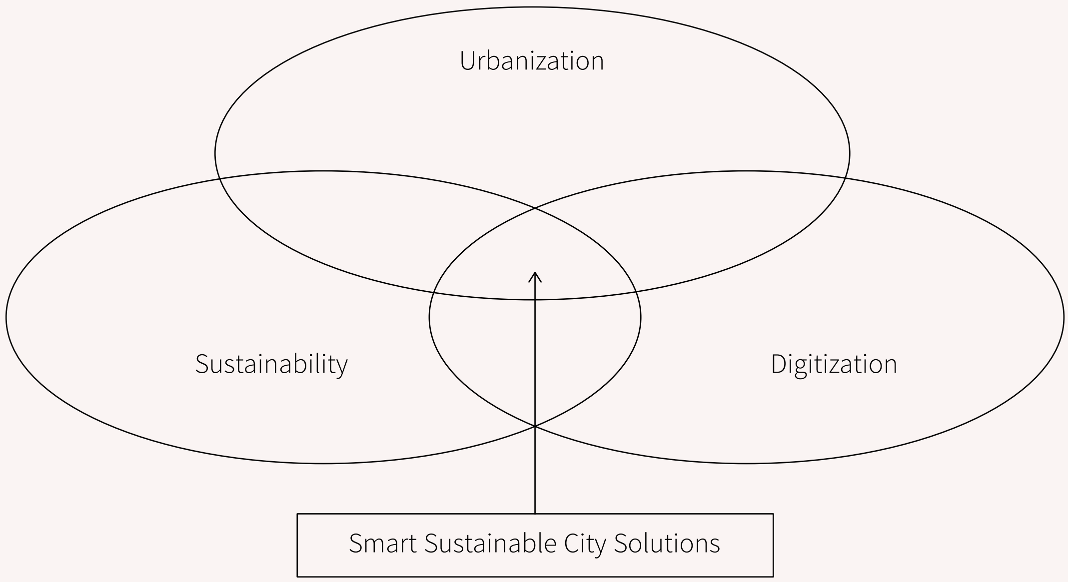

Figure 79: Urbanization, Sustainability and Digitization Domains Revisited

We propose that research problems relevant to Smart Sustainable City research should be formulated based on three premises:

1. *Combined Aspects* – using a combination of at least two "Ps" of the "four Ps" model. A non-exclusive list of combinations include:
    a. examining the existence of a given Problem for a group of People;
    b. analyzing attitudes of People towards a given Problem;
    c. providing solutions through Programs for a given group of People;
    d. evaluating the solution delivered by a Program to a certain Problem faced by a group of People;
    e. assessing the effectiveness of a given Program for a group of People; and
    f. analyzing the characteristics of certain Phenomenon produced by a given Program affecting a group of People.
2. *Intersected Domains* – considering the intersections of at least two of three domains:
    a. Using digitization to address an urbanization issue;
    b. Using digitization to address a sustainability issue;
    c. Driven by sustainability improving urbanization issues;

d. Driven by sustainability, using digitization to address an urbanization issue.

3. *Problem Attributes* – fulfilling the four attributes defined in Section 9.1: relevant, multi-dimensional, researchable and focused.

Research problems defined fulfilling the above premises can be considered part of a research agenda for conducting research on Smart Sustainable Cities.

9.3.2. Examples

Based on the framework proposed above, Table 49 illustrates some research problems.

Table 49: Research Agenda – Example Research Problems

ID	RESEARCH PROBLEM DESCRIPTION	ASPECTS	DOMAINS
1	Designing a methodology for defining Smart City strategy through collaborative processes conducted by city stakeholders	Problem People	Urbanization Sustainability
2	Assessing government leader's attitude towards participatory governance on city planning	People Problem	Sustainability Urbanization
3	Assessing the effectiveness of applying ICT-based surveillance services in public spaces for improving safety of citizens	Program Problem People	Digitization Urbanization Sustainability
4	Designing a middleware solution for the rapid development of mobile apps for disabled people	Program People	Digitization Sustainability
5	Measuring the impact on quality of life of citizens produced by innovations in mobile apps for mobility developed using open data	Phenomenon Program People	Sustainability Digitization Urbanization
6	Assessing the environmental impact of waste prevention and recycling practices adopted by citizens	Phenomenon Program People	Sustainability Urbanization
7	Assessing the effectiveness of applying PPP models supported by cloud services for delivering urban services	Problem Program	Sustainability Digitization
8	Assessing mechanisms for testing ICT-driven innovations in public service delivery through living labs	Problem Program	Digitization Urbanization
9	Designing e-learning platforms for empowering citizens to participate in urban planning	Program Phenomenon People Problem	Digitization Sustainability Urbanization
10	Designing an IT platform for service integration, supporting PPP to improve city transport	Program Problem	Digitization Sustainability Urbanization

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Appendix

A. Research Literature Review

A.1. Selected Papers

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
1	1	2008	Hollands R.G.	Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?	Cross-Sectoral
2	2	2011	Naphade M., Banavar G., Harrison C., Paraszczak J., Morris R.	Smarter cities and their innovation challenges	Cross-Sectoral
3	3	2011	Caragliu A., del Bo C., Nijkamp P.	Smart cities in Europe	Cross-Sectoral
4	4	2000	Steyaert J.	Local governments online and the role of the resident: Government shop versus electronic community	Cross-Sectoral
5	5	2003	Odendaal N.	Information and communication technology and local governance: Understanding the difference between cities in developed and emerging economies	Cross-Sectoral
6	7	2012	Batty M., et.al.	Smart cities of the future	Cross-Sectoral
7	8	2011	Schaffers H., Komninos N., Pallot M., Trousse B., Nilsson M., Oliveira A.	Smart cities and the future internet: Towards cooperation frameworks for open innovation	Cross-Sectoral
8	9	1993	Azegami Moriaki, Fujiyoshi Hideaki	Systematic approach to intelligent building design	Sectoral
9	10	2013	Vlacheas P., et.al..	Enabling smart cities through a cognitive management framework for the internet of things	Sectoral
10	11	2011	Lee J., Baik S., Choonhwa Lee C.	Building an integrated service management platform for ubiquitous cities	Cross-Sectoral
11	12	2011	Allwinkle S., Cruickshank P.	Creating smart-er cities: An overview	Cross-Sectoral
12	13	2008	Price R.K., Vojinovic Z.	Urban food disaster management	Sectoral
13	14	2012	Lazaroiu G.C., Roscia M.	Definition methodology for the smart cities model	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
14	15	2011	Hernandez-Munoz J.M., et.al.	Smart cities at the forefront of the future internet	Sectoral
15	16	2009	Zhu D., Li Y., Shi J., Xu Y., Shen W.	A service-oriented city portal framework and collaborative development platform	Sectoral
16	17	2013	Cardone G., et.al.	Fostering participation in smart cities: A geo-social crowdsensing platform	Cross-Sectoral
17	19	2004	Craglia M., Leontidou L., Nuvolati G., Schweikart J.	Towards the development of quality of life indicators in the 'digital' city	Cross-Sectoral
18	20	2011	Leydesdorff L., Deakin M.	The triple-helix model of smart cities: A neo-evolutionary perspective	Cross-Sectoral
19	21	2010	Zavadskas E.K., Kaklauskas A., Banaitis A.	Application of e-technologies for regional development: The case of Vilnius city	Cross-Sectoral
20	22	2013	GhaffarianHoseini A., Dahlan N.D., Berardi U., GhaffarianHoseini A., Makaremi N.	The essence of future smart houses: From embedding ICT to adapting to sustainability principles	Sectoral
21	23	2012	Schuurman D., Baccarne B., De Marez L., Mechant P.	Smart ideas for smart cities: Investigating crowdsourcing for generating and selecting ideas for ICT innovation in a city context	Cross-Sectoral
22	25	2011	Ergazakis E., Ergazakis K., Askounis D., Charalabidis Y.	Digital cities: Towards an integrated decision support methodology	Cross-Sectoral
23	26	2011	Deakin M., Al Waer H.	From intelligent to smart cities	Cross-Sectoral
24	28	2006	Anthopoulos L., Tsoukalas I.A.	The implementation model of a digital city. The case study of the Digital City of Trikala, Greece: e-Trikala	Sectoral
25	29	2013	Bakici T., Almirall E., Wareham J.	A Smart City Initiative: The Case of Barcelona	Cross-Sectoral
26	30	2013	Komninos N., Pallot M., Schaffers H.	Special Issue on Smart Cities and the Future Internet in Europe	Cross-Sectoral
27	31	2011	Ovaska E., Cinotti T.S., Toninelli A.	The design principles and practices of interoperable smart spaces	Sectoral
28	32	2011	Komninos N.	Intelligent cities: Variable geometries of spatial intelligence	Cross-Sectoral
29	33	2011	Kohno M., Masuyama Y., Kato N., Tobe A.	Hitachi's smart city solutions for new era of urban development	Sectoral
30	34	2013	Vilajosana I., Llosa J., Martinez B., Domingo-Prieto M., Angles A., Vilajosana X.	Bootstrapping smart cities through a self-sustainable model based on big data flows	Cross-Sectoral
31	35	2011	Gann D.M., Dodgson M., Bhardwaj D.	Physical-digital integration in city infrastructure	Cross-Sectoral
32	39	2012	Grant K.A., Chuang S.	An aggregating approach to ranking cities for knowledge-based development	Cross-Sectoral
33	41	2011	Kuk G., Janssen M.	The business models and information architectures of smart cities	Cross-Sectoral
34	42	2010	Zavadskas E.K., Kaklauskas A., Banaitis A.	Real Estate's Knowledge and Device-based Decision Support System	Sectoral
35	43	2014	Neirotti P., De Marco A., Cagliano A.C., Mangano G., Scorrano F.	Current trends in smart city initiatives: Some stylised facts	Cross-Sectoral
36	44	2014	Piro G., Cianci I., Grieco L.A., Boggia G., Camarda P.	Information centric services in Smart Cities	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
37	46	2013	Joss S., Cowley R., Tomozeiu D.	Towards the 'ubiquitous eco-city': An analysis of the internationalisation of eco-city policy and practice	Sectoral
38	47	2012	Anthopoulos L.G., Vakali A.	Urban planning and smart cities: Interrelations and reciprocities	Sectoral
39	48	2011	Bailey A., Ngwenyama O.	The challenge of e-participation in the digital city: Exploring generational influences among community telecentre users	Sectoral
40	49	2010	Santinha G., de Castro E.A.	Creating more intelligent cities: The role of ICT in promoting territorial governance	Cross-Sectoral
41	52	2013	Zygiaris S.	Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems	Cross-Sectoral
42	54	2013	Girard L.F.	Toward a smart sustainable development of port cities/areas: The role of the "Historic Urban Landscape" approach	Cross-Sectoral
43	56	2012	Calderoni L., Maio D., Palmieri P.	Location-aware mobile services for a smart city: Design, implementation and deployment	Sectoral
44	57	2012	Wang Y., Wu Y.	Research on smart construction concept and it's supportive system	Sectoral
45	58	2012	Tranos E., Gertner D.	Smart networked cities?	Cross-Sectoral
46	59	2011	Teles A., Joia L.A.	Assessment of digital inclusion via the actor-network theory: The case of the Brazilian municipality of PiraÃ	Sectoral
47	60	2011	Dodgson M., Gann D.	Technological Innovation and Complex Systems in Cities	Cross-Sectoral
48	61	2004	Liu L., Huang Y.	How to make the development strategies for digital city	Sectoral
49	62	2003	Firmino R.J.	"Not just portals:" Virtual cities as complex sociotechnical phenomena	Sectoral
50	63	2014	Vanolo A.	Smartmentality: The Smart City as Disciplinary Strategy	Cross-Sectoral
51	64	2014	Gabrys J.	Programming environments: Environmentality and citizen sensing in the smart city	Cross-Sectoral
52	65	2014	Hu X., Li X., Ngai E.C.-H., Leung V.C.M., Kruchten P.	Multidimensional context-aware social network architecture for mobile crowdsensing	Sectoral
53	66	2013	Ylipulli J., Suopajarvi T.	Contesting ubicomp visions through ICT practices: Power negotiations in the meshwork of a technologised city	Sectoral
54	67	2013	Herrschel T.	Competitiveness AND Sustainability: Can 'Smart City Regionalism' Square the Circle?	Cross-Sectoral
55	68	2013	Mulligan C.E.A., Olsson M.	Architectural implications of smart city business models: An evolutionary perspective	Cross-Sectoral
56	69	2013	Hielkema H., Hongisto P.	Developing the Helsinki Smart City: The Role of Competitions for Open Data Applications	Sectoral
57	70	2012	Schaffers H., Ratti C., Komninos N.	Special issue on smart applications for smart cities - new approaches to innovation: Guest editors' introduction	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
58	71	2012	Xiong Z., Sheng H., Rong W.G., Cooper D.E.	Intelligent transportation systems for smart cities: A progress review	Sectoral
59	72	2012	Kourtit K., Nijkamp P., Arribas D.	Smart cities in perspective - a comparative European study by means of self-organizing maps	Cross-Sectoral
60	73	2011	Tang L., Lin L., Shao G., Su X., Zhao J.	Redefining the digital city for promoting sustainable urban development	Sectoral
61	76	2010	Malek J.A.	Informative global community development index of intelligent city	Sectoral
62	78	2008	Hudson-Smith A., Milton R., Dearden J., Batty M.	The neogeography of virtual cities: Digital mirrors into a recursive world	Sectoral
63	79	2001	Oyama S., Hiramatsu K., Ishida T.	Cooperative information agents for digital cities	Sectoral
64	81	2014	Watson V.	African urban fantasies: Dreams or nightmares?	Cross-Sectoral
65	82	2014	Li D., Yao Y., Shao Z.	Big data in smart city	Cross-Sectoral
66	83	2014	Aloi G., Bedogni L., Di Felice M., Loscri V., Molinaro A., Natalizio E., Pace P., Ruggeri G., Trotta A., Zema N.R.	STEM-Net: An evolutionary network architecture for smart and sustainable cities	Sectoral
67	84	2014	Cimmino A., et.al.	The role of small cell technology in future smart city applications	Cross-Sectoral
68	85	2014	Yamauchi T., Kutami M., Konishi-Nagano T.	Development of quantitative evaluation method regarding value and environmental impact of cities	Cross-Sectoral
69	86	2014	Jara A.J., Lopez P., Fernandez D., Castillo J.F., Zamora M.A., Skarmeta A.F.	Mobile digcovery: Discovering and interacting with the world through the Internet of things	Sectoral
70	87	2013	Sanchez L., Elicegui I., Cuesta J., Munoz L., Lanza J.	Integration of utilities infrastructures in a future internet enabled smart city framework	Cross-Sectoral
71	88	2013	Lee C.S., Lee G.M., Rhee W.S.	Standardization and challenges of smart ubiquitous networks in ITU-T	Sectoral
72	89	2013	Pearsall H.	Superfund Me: A Study of Resistance to Gentrification in New York City	Sectoral
73	90	2013	Carvalho L., Campos J.B.	Developing the PlanIT valley: A view on the governance and societal embedding of u-eco city pilots	Cross-Sectoral
74	91	2013	Carter D.	Urban Regeneration, Digital Development Strategies and the Knowledge Economy: Manchester Case Study	Cross-Sectoral
75	92	2012	Caragliu A., Del Bo C., Kourtit K., Nijkamp P., Suzuki S.	In search of incredible cities by means of super-efficiency data envelopment analysis	Cross-Sectoral
76	95	2012	Deakin M.	Intelligent cities as smart providers: CoPs as organizations for developing integrated models of eGovernment Services	Sectoral
77	97	2012	Ge G.	City information network construction-discuss based on the idea of intelligent city	Cross-Sectoral
78	99	2011	Walters D.	Smart cities, smart places, smart democracy: Form-based codes, electronic governance and the role of place in making smart cities	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
79	100	2011	Hogan J., Meegan J., Parmar R., Narayan V., Schloss R.J.	Using standards to enable the transformation to smarter cities	Cross-Sectoral
80	101	2011	Juan Y.-K., Wang L., Wang J., Leckie J.O., Li K.-M.	A decision-support system for smarter city planning and management	Sectoral
81	102	2010	Ortiz-Fournier L.V., Marquez E., Flores F.R., Rivera-Vazquez J.C., Colon P.A.	Integrating educational institutions to produce intellectual capital for sustainability in Caguas, Puerto Rico	Cross-Sectoral
82	105	2001	Graf P.	Information and communication technologies in the city [Informations- und Kommunikationstechnologien in der Stadt]	Cross-Sectoral
83	106	2014	Lee J.H., Hancock M.G., Hu M.-C.	Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco	Cross-Sectoral
84	107	2014	Debnath A.K., Chin H.C., Haque M.M., Yuen B.	A methodological framework for benchmarking smart transport cities	Sectoral
85	109	2014	Kitchin R.	The real-time city? Big data and smart urbanism	Cross-Sectoral
86	110	2014	Calderoni L., Maio D., Rovis S.	Deploying a network of smart cameras for traffic monitoring on a “city kernel”	Sectoral
87	113	2014	Glebova I.S., Yasnitskaya Y.S., Maklakova N.V.	Assessment of cities in Russia according to the concept of “smart city” in the context of the application of information and communication technologies	Cross-Sectoral
88	114	2014	Attour A., Rallet A.	The role of territories in the development of local trans-sectoral system of innovation: The case of smart cities	Cross-Sectoral
89	115	2014	Fernandez C., Manya F., Mateu C., Sole-Mauri F.	Modeling energy consumption in automated vacuum waste collection systems	Sectoral
90	117	2014	Kutami M., Takeno M., Ioka H.	New approach for environmental future city created by ICT: Sustainable city network	Cross-Sectoral
91	119	2014	Moreno M.V., Zamora M.A., Skarmeta A.F.	User-centric smart buildings for energy sustainable smart cities	Sectoral
92	122	2013	Kostakos V., Ojala T., Juntunen T.	Traffic in the smart city: Exploring city-wide sensing for traffic control center augmentation	Sectoral
93	123	2013	Wachowicz M.	New frontiers for geomatics	Sectoral
94	124	2013	Dierwechter Y.	Smart city-regionalism across Seattle: Progressing transit nodes in labor space?	Sectoral
95	126	2013	Iwamura K., Mizuno Y., Mashita Y.	Information and control platform for smarter social infrastructure	Sectoral
96	127	2013	Maruyama Y., Hoshino T., Ishikawa T., Akashi T.	Methodology research and development for designing future experience	Sectoral
97	128	2013	Weinstock M., Gharleghi M.	Intelligent cities and the taxonomy of cognitive scales	Cross-Sectoral
98	129	2013	Gu X.-J., Dai F., Chen J.-X., Yang Q.-H., Qi G.-N.	Relationship between smarter manufacturing and smarter city	Cross-Sectoral
99	130	2013	Komninos N., Tsarchopoulos P.	Toward Intelligent Thessaloniki: From an Agglomeration of Apps to Smart Districts	Sectoral
100	132	2012	Sauer S.	Do smart cities produce smart entrepreneurs?	Sectoral
101	133	2012	Keegan S., O’Hare G., O’Grady M.	Retail in the digital city	Sectoral
102	135	2012	Sakaguchi H., Kagawa Y., Kazama Y.	Satellite imagery solution for natural resources	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
103	136	2011	Gotzenbrucker G., Kohl M.	Intelligent Mobility: Potentials and Impacts of Multimodal Traveller Information Systems - the Case of AnachB.at in Vienna	Sectoral
104	137	2011	Jutraz A., Voigt A., Zupancic T.	3D city models as understandable design interfaces fo§	Sectoral
105	139	2011	Cruickshank P.	Scran: The network	Cross-Sectoral
106	142	2009	Lefevre B.	Urban transport energy consumption: Determinants and strategies for its reduction an analysis of the literature	Sectoral
107	143	2008	Anthopoulos L.G.	Collaborative enterprise architecture for municipal environments	Sectoral
108	144	2008	Aurigi A.	What you don't see is (also) what you get: Invisible flows and the shaping of media-rich cities	Sectoral
109	145	2007	Zhang J.-X., Jiang J.-B., Bai M.-Z.	Development of urban public transportation WebGIS	Sectoral
110	147	2005	Nunes F.	Aveiro, Portugal: Making a digital city	Cross-Sectoral
111	149	2000	Firmeza J.P., Fontes F.	Aveiro digital city: A case study for a multi-services community network	Sectoral
112	150	2015	Das D.	Hyderabad: Visioning, restructuring and making of a high-tech city	Sectoral
113	151	2015	Krishnamurthy R., Desouza K.C.	Chennai, India	Sectoral
114	152	2015	Ryu M., Kim J., Yun J.	Integrated semantics service platform for the internet of things: A case study of a smart office	Sectoral
115	153	2014	Paroutis S., Bennett M., Heracleous L.	A strategic view on smart city technology: The case of IBM Smarter Cities during a recession	Cross-Sectoral
116	155	2014	Carvalho L., Santos I.P., Van Winden W.	Knowledge spaces and places: From the perspective of a "born- global" start-up in the field of urban technology	Cross-Sectoral
117	157	2014	Bianchini D., Avila I.	Smart cities and their smart decisions: Ethical considerations	Cross-Sectoral
118	158	2014	Orlowski C.	Rule-based model for selecting integration technologies for smart cities systems	Cross-Sectoral
119	160	2014	Lopez J.C., Villanueva F.J.	University and innovation towards smart cities [Universidad e innovacion hacia la ciudad inteligente]	Cross-Sectoral
120	161	2014	Maloney C.	Sustainable mobility for smart cities [Movilidad sostenible para ciudades inteligentes]	Sectoral
121	162	2014	Doran M.-A., Daniel S.	Geomatics and Smart City: A transversal contribution to the Smart City development	Sectoral
122	163	2014	Uzumaki T.	Technologies for reducing environmental load of next-generation smart cities	Cross-Sectoral
123	164	2014	Gabarrell X., et.al.	Plugrisost: A model for design, economic cost and environmental analysis of rainwater harvesting in urban systems	Sectoral
124	165	2014	Heo T., Kim K., Kim H., Lee C., Ryu J.H., Leem Y.T., Jun J.A., Pyo C., Yoo S.-M., Ko J.G.	Escaping from ancient Rome! applications and challenges for designing smart cities	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
125	166	2014	Marsal-Llacuna M.-L., Lopez-Ibanez M.-B.	Smart Urban Planning: Designing Urban Land Use from Urban Time Use	Sectoral
126	168	2014	Anttiroiko A.-V., Valkama P., Bailey S.J.	Smart cities in the new service economy: Building platforms for smart services	Cross-Sectoral
127	169	2014	Jucevicius R.	Strategic dimensions of the development of smart city	Cross-Sectoral
128	170	2014	Horng G.-J.	The Adaptive Recommendation Mechanism for Distributed Parking Service in Smart City	Sectoral
129	171	2014	Torroba P.G.	Values and services in the smart city [Valores y servicios en la ciudad inteligente]	Cross-Sectoral
130	172	2014	Robuste F.	Smart city logistics [Smart city logistics]	Sectoral
131	173	2014	Shu Y., Fan J.	Progress in smart city standardization	Cross-Sectoral
132	174	2014	Emura F., Takayama M., Sugita H., Hiraoka K., Yamazaki T.	Automotive technologies for smart cities and their global deployment	Sectoral
133	176	2014	Lee J., Lee H.	Developing and validating a citizen-centric typology for smart city services	Cross-Sectoral
134	177	2014	Aamir M., Uqaili M.A., Amir S., Chowdhry B.S., Rafique F., Poncela J.	Framework for analysis of power system operation in smart cities	Sectoral
135	178	2014	Bechini A., Marcelloni F., Segatori A.	Low-effort support to efficient urban parking in a smart city perspective	Sectoral
136	179	2014	Maier S., Narodoslawsky M.	Optimal Renewable Energy Systems for Smart Cities	Sectoral
137	181	2014	Patasiene I., Patasius M.	Digital dimension in smart city: Case of cities of Baltic countries	Cross-Sectoral
138	182	2014	Chen Z., Xu Z., Li Q., Lu W., Xiong Z.	A novel framework of data sharing and fusion in smart city-SCLDF	Sectoral
139	183	2014	De La Serna Hernaiz I.	The challenge of becoming smart city [El reto de convertirse en smart city]	Cross-Sectoral
140	184	2014	Ausaverri M.	Comprehensive view of a city focused on efficiency and sustainability: Smart city	Cross-Sectoral
141	185	2014	Sonoda T., Kitajima H., Takahashi S.	Trend and technology development of demand response	Sectoral
142	187	2014	Sivarajah U., Lee H., Irani Z., Weerakkody V.	Fostering smart cities through ICT driven policy-making: Expected outcomes and impacts of DAREED project	Sectoral
143	188	2014	Aldama Gutierrez E.A.	Road safety and enforcement management systems in urban areas	Sectoral
144	189	2014	Hsieh H.-N., Chou C.-Y., Chen Y.-Y., Hou C.-Y.	Applying a fuzzy delphi method to construct intelligent city indicators: A case study of taichung	Cross-Sectoral
145	191	2014	Duarte F., Figueiredo F.C., Leite L., Rezende D.A.	A Conceptual Framework for Assessing Digital Cities and the Brazilian Index of Digital Cities: Analysis of Curitiba, the First-Ranked City	Sectoral
146	193	2014	Galeeva A., Mingazova N., Gilmanshin I.	Sustainable urban development: Urban green spaces and water bodies in the city of Kazan, Russia	Sectoral
147	194	2014	Jucevicius R., Liugailaite-Radzvickiene L.	The evaluation of city's intelligence	Cross-Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
148	195	2014	Liu Y., Wei J., Rodriguez A.F.C.	Development of a strategic value assessment model for smart city	Cross-Sectoral
149	196	2014	Santos A.S., Yoshioka L.R., Marte C.L., Cintra J.P., Fontana C.	Optimal placement of sensor network hosted in public transport vehicles for environmental monitoring	Sectoral
150	197	2014	Pellejero G., Serna S.	The century of cities [El siglo de las ciudades]	Cross-Sectoral
151	200	2014	Freile J.L.N.	Technological development of smart cities	Cross-Sectoral
152	201	2014	Galindo F.	Methods for law and ICT: An approach for the development of smart cities	Cross-Sectoral
153	202	2014	Sanchez Bernabeu J.M., Berna Martinez J.V., Macia Perez F.	Smart sentinel: Monitoring and prevention system in the smart cities	Sectoral
154	204	2014	Avello A.A.	Sustainability in the city of the future: The challenges that confront the cities of the 21st century	Cross-Sectoral
155	205	2014	Elmaghraby A.S., Losavio M.M.	Cyber security challenges in smart cities: Safety, security and privacy	Sectoral
156	206	2014	Wang J., Li C., Xiong Z., Shan Z.	Survey of data-centric Smart City	Sectoral
157	207	2014	Takahira S., Kanamori R., Ito T.	Experiment on activity-travel survey system based on scheduling system	Sectoral
158	208	2014	Saez-Martin A., Haro-de-Rosario A., Caba-Perez C.	A vision of social media in the Spanish smartest cities	Sectoral
159	209	2014	Deakin M.	Smart cities: the state-of-the-art and governance challenge	Cross-Sectoral
160	211	2014	Tada N., Marui M., Mizutani A.	Promotion of smart community in aizuwakamatsu city area	Sectoral
161	212	2014	Rong W., Xiong Z., Cooper D., Li C., Sheng H.	Smart city architecture: A technology guide for implementation and design challenges	Cross-Sectoral
162	214	2014	Khan Z., Kiani S.L., Soomro K.	A framework for cloud-based context-aware information services for citizens in smart cities	Cross-Sectoral
163	216	2014	Vives A.	Barcelona, project and social dream	Cross-Sectoral
164	217	2014	Byun J.-Y., Nasridinov A., Park Y.-H.	Internet of things for smart crime detection	Sectoral
165	218	2014	Cheng S.-T., Li J.-P., Horng G.-J., Wang K.-C.	The adaptive road routing recommendation for traffic congestion avoidance in smart city	Sectoral
166	219	2014	Vitaliev V.	Factory of light	Sectoral
167	220	2014	Nam T., Pardo T.A.	The changing face of a city government: A case study of Philly311	Cross-Sectoral
168	221	2014	Casado H.	How to boost innovation from public administration	Cross-Sectoral
169	222	2014	Kii M., Akimoto K., Doi K.	Measuring the impact of urban policies on transportation energy saving using a land use-transport model	Sectoral
170	223	2014	Trachana A.	Hybrid city mediation of ICT in the city experience	Sectoral
171	224	2014	Liu J., Fang Y., Guo C., Gao K.	Research progress in location big data analysis and processing	Sectoral
172	225	2014	Escolar S., Carretero J., Marinescu M.-C., Chessa S.	Estimating energy savings in smart street lighting by using an adaptive control system	Sectoral
173	226	2014	Diaz Pineda J., De La Pena Gonzalez E.	Smart road, the highway of the XXI century ["Smart road", la carretera del siglo XXI]	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
174	227	2014	Garau C.	From Territory to Smartphone: Smart Fruition of Cultural Heritage for Dynamic Tourism Development	Sectoral
175	229	2013	Li D.	Application of high-resolution earth observation technology in smart city	Sectoral
176	230	2013	Qin L., Li Y., Yao C.	Three-dimensional modeling of simulation scene in campus navigation system	Sectoral
177	231	2013	Rezende D.A.	Public information: Brazilian strategic digital city project	Sectoral
178	232	2013	Galdon-Clavell G.	(Not so) smart cities?: The drivers, impact and risks of surveillance enabled smart environments	Cross-Sectoral
179	233	2013	Eric L.	Next generation information-based infrastructures: New dependencies and threats	Sectoral
180	234	2013	Xiong Y.-Y., Chen Y.-B., Qian Q.-L., Wang S.-S.	3D simulation of typical pollutants diffusion in chemical industrial park based on computer graphics techniques	Sectoral
181	236	2013	Marot Dr. N.	Dunaj	Sectoral
182	237	2013	Marciano C.	Unpacking a smart city model: The hegemony of ecological and information paradigms in urban Space	Cross-Sectoral
183	238	2013	Liu P., Peng Z.	Implementation technologies and procedure of the real-time interactive roaming system of virtual city	Sectoral
184	241	2013	Chochliouros I.P., Spiliopoulou A.S., Sfakianakis E., Georgiadou E.M., Rethimiotaki E.	Living labs in smart cities as critical enablers for making real the modern future internet	Sectoral
185	244	2013	Fregonara E., Curto R., Grosso M., Mellano P., Rolando D., Tulliani J.-M.	Environmental Technology, Materials Science, Architectural Design, and Real Estate Market Evaluation: A Multidisciplinary Approach for Energy-Efficient Buildings	Sectoral
186	245	2013	Badii A., Carboni D., Pintus A., Piras A., Serra A., Tiemann M., Viswanathan N.	Cityscripts: Unifying web, iot and smart city services in a smart citizen workspace	Cross-Sectoral
187	246	2013	Birdsall M.	Industry buzz	Sectoral
188	248	2013	Kwon J., Kim H.	Design and evaluation of USN-based environmental air pollution monitoring system in subway systems	Sectoral
189	249	2013	Hong L., Zhou Z., Fang M., Li X., Cheng F.	Exploration and practice of low-level UAV aerial platform	Sectoral
190	250	2013	Liang Y., Ying R., Liu P.	Model based application level middleware for design of wireless smart city	Sectoral
191	251	2013	Aurigi A.	Reflections towards an agenda for urban-designing the digital city	Sectoral
192	253	2013	Alderson J.	Smart cities of tomorrow	Cross-Sectoral
193	254	2013	Schmidt R.-R., Page J., Pol O.	Towards smart cities: Challenges and opportunities for thermal Urban networks	Sectoral
194	255	2013	Song Z.	An application of cloud computing in the sharing service platform	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
195	256	2013	Lupo E., Ozdil E.	Towards a "smart heritage" As future diffused museums: Design and communication technologies to innovate the experience of the cultural patrimony in smart cities	Sectoral
196	259	2012	Ju D., Shen B.	Internet of knowledge and knowledge cloud service	Sectoral
197	260	2012	Rantakokko M.	Smart city as an innovation engine: Case Oulu	Cross-Sectoral
198	262	2012	Maclennan B.L., Bergeron S.J.	3D digital city platforms as collaborative and decision-making tools for small municipalities and rural areas	Sectoral
199	264	2012	Hsieh H.-N., Hu T.-S., Chia P.-C., Hou C.-Y., Lo H.-M.	A preliminary study of emergence and development from the regional innovation systems to intelligent city-region	Cross-Sectoral
200	265	2012	Yusof N., Van Loon J.	Engineering a global city: The case of Cyberjaya	Cross-Sectoral
201	266	2012	Fei L.	Smart city development level assessment for Tianjin using AHP and gray comprehensive evaluation	Cross-Sectoral
202	267	2012	Diez T.	Personal Fabrication: Fab Labs as Platforms for Citizen-Based Innovation, from Microcontrollers to Cities	Sectoral
203	268	2012	Okuya S.	M2M and big data to realize the smart city	Sectoral
204	269	2012	Neves B.B.	Enabling local development through digital cities: Examples from Portugal	Sectoral
205	270	2012	Dietrich D., Kupzog F., Haase J.	Cyber physical systems describing new energy supply systems	Sectoral
206	271	2012	Pol O., Palensky P., Kuh C., Leutgob K., Page J., Zucker G.	Integration of centralized energy monitoring specifications into the planning process of a new urban development area: A step towards smart cities	Sectoral
207	272	2012	Srivastava L., Vakali A.	Towards a narrative-aware design framework for smart urban environments	Cross-Sectoral
208	273	2012	Malek J.A., Razak N.A., Nor N.F.M.	Post intelligent city development and hyperrealism of E-Community in Malaysia	Sectoral
209	274	2012	Saitou K., Tsuji K., Mukouyama K., Kanamaru Y., Wakao I.	Development of large-scale energy storage systems and the strategy of global deployment	Sectoral
210	275	2012	Rissen K., Sano Y., Shimazu H., Kawai S.	Electric vehicle charging solution for smart cities	Sectoral
211	276	2012	Noor A.K.	Emerging interdisciplinary fields in the coming intelligence/convergence era	Sectoral
212	277	2012	Vicini S., Bellini S., Sanna A.	The city of the future living lab	Sectoral
213	278	2011	Izumi H., Yamashita A.	Current and future trends of M2M services	Sectoral
214	279	2011	Spais G.S.	The case of region marketing of a Greek Southwestern City: Building a new image and personality of open innovation and creativity	Sectoral
215	280	2011	Boikova M., Ilyina I., Salazkin M.	Urban futures: Cities as agents of globalization and innovation	Cross-Sectoral
216	281	2011	Sridhar V., Sridhar K.S.	Are cities in India digital yet? Some evidence	Cross-Sectoral
217	282	2011	Frank I.	Smart festival	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
218	283	2011	Al-Hader M., Rodzi A., Sharif A.R., Ahmad N.	Mobile laser scanning to spatially update the city infrastructure networks	Sectoral
219	285	2011	Oda T., Morichi R., Umeki H., Kanda S.	Energy saving solutions for sustainable growth of industry	Sectoral
220	286	2011	Liu X., Li C., Ma Z., Wang J., Sun W.	A super data-sharing model in common platform of geographic information	Sectoral
221	287	2011	Kurebayashi T., Masuyama Y., Morita K., Taniguchi N., Mizuki F.	Global initiatives for smart urban development	Cross-Sectoral
222	288	2011	Lesgards V.	Grappes d’innovations sur les rÃ©seaux Ã©lectriques et les concessions des collectivitÃ©s locales (eau, dÃ©chets). Une lecture scumpeterienne du smart grid	Sectoral
223	289	2011	Huestis E.M., Snowdon J.L.	Complexity of legacy city resource management and value modeling of interagency response	Cross-Sectoral
224	290	2010	Barclay S.	Streetline joins SAP partneredge as a software solution partner	Sectoral
225	291	2010	Zheng Z., Lu X., Zhang C., Yu Z.	3DSurs positioning technology with CORS and its application	Sectoral
226	292	2010	Longworth N., Osborne M.	Six ages towards a learning region - a retrospective	Cross-Sectoral
227	294	2010	Wu X.-C.	The new generation integration development platform for digital city	Sectoral
228	295	2009	Ercoskun O.Y.	Green urban planning and design for smarter communities	Cross-Sectoral
229	296	2009	Wachter S.	Promises and impasses of digital architecture [Promesses et impasses de l’architecture numÃ©rique]	Sectoral
230	299	2009	Kim M.Y., Yeo W.H., Choi J.W.	Developing a multi-dimensional spatio-visual information system	Sectoral
231	300	2008	Lombardi P., Curwell S.	Evaluation of Scenarios of a Southern-European Intelligent City of the Future	Cross-Sectoral
232	301	2007	Baumann J.	Cape town’s emphasis on systems integration exemplifies ‘smart city’ goals	Sectoral
233	302	2007	Zheng L.-P., Li G.-Y., Sha J.	Survey of urban simulation technology	Sectoral
234	303	2007	Moutinho J.L., Heitor M.	Building human-centered systems in the network society	Sectoral
235	304	2005	An X.	Evaluation of research project on integrated management and services of urban development records, archives, and information	Cross-Sectoral
236	305	2005	Li Z.-Q., Nie G.-Z., Su G.-W.	Digital city and the information management system for earthquake disaster reduction	Sectoral
237	307	2005	Qian Y.-M., Tan H.-Q.	Foundational platform for digital urban and rural planning based on GIS	Sectoral
238	308	2004	Wang Y.-W., Guo H.-L.	Research and application of key technologies for a network of digital community	Sectoral
239	309	2004	Liu Q., Li J., Gan R.-C.	Analysis and design of an information system for urban underground pipelines purposed at information sharing	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
240	311	2014	Fernandes R.F., Fonseca C.C., Brandao D., Ferrari P., Flammini A., Vezzoli A.	Flexible Wireless Sensor Network for smart lighting applications	Sectoral
241	312	2015	Redmond A., Fies B., Zarli A.	Developing an integrated cloud platform for enabling 'holistic energy management' in urban areas	Sectoral
242	313	2015	Poveda-Villalon M., Garcia-Castro R., Gomez-Perez A.	Building an ontology catalogue for smart cities	Sectoral
243	314	2014	Candelieri A., Archetti F., Giordani I., Arosio G., Sormani R.	Smart cities management by integrating sensors, models and user generated contents	Sectoral
244	315	2014	Liu R., Liu Y., Huang Z.	Research on the digital city geospatial framework construction	Sectoral
245	316	2014	Patrascu M., Dragoicea M.	Integrating agents and services for control and monitoring: Managing emergencies in smart buildings	Sectoral
246	317	2014	Zhang L.	Design and implementation of NGDC geospatial metadata management system	Sectoral
247	318	2014	Zhu Y.Q., Zuo J.	Research on system development of smart city	Cross-Sectoral
248	319	2014	Horng G.-J.	The adaptive recommendation segment mechanism to reduce traffic congestion in smart city	Sectoral
249	321	2014	Wang K., Chen J., Zheng Z.	Insigma's technological innovation ecosystem for implementing the strategy of Green Smart city	Cross-Sectoral
250	322	2014	Vakali A., Anthopoulos L., Krco S.	Smart cities data streams integration: Experimenting with internet of things and social data flows	Sectoral
251	323	2014	Giesecke R.	The electric mobility business ecosystem	Sectoral
252	324	2014	Petrolo R., Mitton N., Soldatos J., Hauswirth M., Schiele G.	Integrating wireless sensor networks within a city cloud	Sectoral
253	325	2014	Gouidis F., Flouris G., Plexousakis D.	A demo for smart city operation center	Sectoral
254	326	2014	Feuillien M.H., Van Vooren M.P.	The BRIC, instrument of urban intelligence for the Brussels-Capital Region	Cross-Sectoral
255	327	2014	Di Napoli C., Di Nocera D., Rossi S.	Using negotiation for parking selection in smart cities	Sectoral
256	328	2014	Foulonneau M., Martin S., Turki S.	How Open Data are turned into services?	Sectoral
257	329	2014	Ojo A., Curry E., Janowski T.	Designing next generation smart city initiatives - Harnessing findings and lessons from a study of ten smart city programs	Cross-Sectoral
258	330	2014	Gong Y., Han P.	Research on energy-saving scheme based on LED street lamp management-system	Sectoral
259	331	2014	Xu S.M., Liu Y., Chen X.Y., Huang L., Yang Y.B., Yu K., Liao Y.C.	The implementation pattern of smart distribution grid and utilization	Sectoral
260	332	2014	Hughes C.E.	Human surrogates: Remote presence for collaboration and education in Smart Cities	Sectoral
261	333	2014	Siming W., Hui L.	Clever urban development and circular economy	Cross-Sectoral
262	334	2014	Turchi S., Paganelli F., Bianchi L., Giuli D.	A lightweight linked data implementation for modeling the Web of Things	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
263	336	2014	Androulaki S., Spiliotis E., Doukas H., Papastamatiou I., Psarras J.	Proposing a Smart City Energy Assessment Framework linking local vision with data sets	Sectoral
264	337	2014	Cohen S., Money W., Quick M.	Improving integration and insight in smart cities with policy and trust	Cross-Sectoral
265	338	2014	Tragos E.Z., Angelakis V., Fragkiadakis A., Gundlegard D., Nechifor C.-S., Oikonomou G., Pohls H.C., Gavras A.	Enabling reliable and secure IoT-based smart city applications	Sectoral
266	339	2014	Mulder I.	Sociable smart cities: Rethinking our future through co-creative partnerships	Cross-Sectoral
267	341	2014	Lai F.H.S.	Examining the functionality and usability of interactive wayfinding design within cities in china	Sectoral
268	343	2014	Galache J.A., Yonezawa T., Gurgen L., Pavia D., Grella M., Maeomichi H.	ClouT: Leveraging cloud computing techniques for improving management of massive IoT data	Sectoral
269	345	2014	Maccani G., Donnellan B., Helfert M.	Action design research in practice: The case of Smart Cities	Cross-Sectoral
270	347	2014	Hosio S., Goncalves J., Kukka H.	Situated engagement and virtual services in a smart city	Cross-Sectoral
271	348	2014	Khanam S., Noor M.J.M.M.	A comparative static analysis of carbon tax policy and a 'Smart City-JB', Johor Bahru, Malaysia	Sectoral
272	349	2014	Bellavista P., Foschini L., Zamagni E.	V2X Protocols for low-penetration-rate and cooperative traffic estimations	Sectoral
273	350	2014	Musto C., et.al.	Developing a semantic content analyzer for L'Aquila social urban network	Sectoral
274	351	2014	Costanzo A., Faro A., Giordano D.	Pervasive ambient intelligence platforms in the iot era based on a ubiquitous user model ontology: An implementation account	Sectoral
275	352	2014	Wright P., Manieri A.	Internet of things in the cloud theory and practice	Sectoral
276	353	2014	Longo M., Zaninelli D., Roscia M., Costoiu M.	Smart City to improve power quality	Sectoral
277	354	2014	Dai H.B., Yue X.J., Xu J.Y.	A research on digital city three-dimensional visualization system based on skyline	Sectoral
278	356	2014	Kakarontzas G., Anthopoulos L., Chatzakou D., Vakali A.	A conceptual enterprise architecture framework for smart cities: A survey based approach	Cross-Sectoral
279	357	2014	Namiot D., Sneps-Sneppe M.	On software standards for smart cities: API or DPI	Sectoral
280	358	2014	Rizzo F., Deserti A.	Small scale collaborative services: The role of design in the development of the human smart city paradigm	Sectoral
281	359	2014	Wang B., Gao Y., Shi Q.H., Zheng Y.H., Sun Z.G.	Research on technology system of smart residential district in China	Cross-Sectoral
282	360	2014	Cenedese A., Zanella A., Vangelista L., Zorzi M.	Padova smart City: An urban Internet of Things experimentation	Sectoral
283	362	2014	Calvillo C.F., Sanchez A., Villar J.	Evaluation and optimal scaling of distributed generation systems in a smart city	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
284	363	2014	Li M.	The developing of query and analysis system for 3D digital city	Sectoral
285	364	2014	Stuchly J., Misak S., Vramba J., Uher M., Kubalik P.	Control of autonomous active distribution grid - Introduction	Sectoral
286	365	2014	Gora P., Wasilewski P.	Adaptive system for intelligent traffic management in smart cities	Sectoral
287	366	2014	Li X.Q., Zhang W., Tao C.Y., Wang Y.X.	Study based on mixed scanning method-taking Gongqing Digital Eco City as an example	Sectoral
288	367	2014	Cecchinel C., Mosser S., Collet P.	Software development support for shared sensing infrastructures: A generative and dynamic approach	Sectoral
289	368	2014	Mao Y., Li H., Yang B.	A systematic solution to the smart city - Distinguished from the intelligent city	Sectoral
290	369	2014	Khanna A., Venters W.	Exploring the rhythms of information infrastructure coordination for smart cities: The case of building a mobility infrastructure in Berlin	Sectoral
291	370	2014	Elmangoush A., Steinke R., Al-Hezmi A., Magedanz T.	On the usage of standardised M2M platforms for smart energy management	Sectoral
292	371	2014	Clohessy T., Morgan L., Acton T.	An exploratory study into it governance implementations in living laboratory ecosystems and their impact on open innovation effectiveness	Sectoral
293	372	2014	Pohls H.C., et.al.	RERUM: Building a reliable IoT upon privacy- and security- enabled smart objects	Sectoral
294	373	2014	Despouys R., Sharrock R., Demeure I.	Sensemaking in the autonomic smart-home	Sectoral
295	374	2014	Di Staso U., Magliocchetti D., De Amicis R.	Smart-Islands: Enhancing user experience for mediterranean Islands for tourism support	Sectoral
296	375	2014	Tei K., Gurgen L.	ClouT : Cloud of things for empowering the citizen clout in smart cities	Sectoral
297	376	2014	Wang R.M., Tian W., Cao Y., Yan M.F., Gao J.	Smart grid implementation strategies and practices in smart city	Sectoral
298	377	2014	Smith E., Ugolini M., Neri A.	The business requirements and technical fabric for the Smart City	Cross-Sectoral
299	378	2014	Hui Z., Kuan H.	Design of rapid workflow building smart city system platform based on intelligent spreadsheets	Cross-Sectoral
300	380	2014	Fanti M.P., Mangini A.M., Roccotelli M.	A Petri Net model for a building energy management system based on a demand response approach	Sectoral
301	382	2014	Khansari N., Mostashari A., Mansouri M.	Conceptual modeling of the impact of smart cities on household energy consumption	Sectoral
302	383	2014	Christopoulou E., Ringas D., Garofalakis J.	The vision of the sociable smart city	Cross-Sectoral
303	384	2014	Fu Z., Lin X.	Building the co-design and making platform to support participatory research and development for smart city	Sectoral
304	385	2014	Perez D., Villaverde M., Moreno F., Nogar N., Ezcurra F., Aznar E.	Low-cost radar-based target identification prototype using an expert system	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
305	386	2014	Li X.Q., Zhang W., Tao C.Y., Wang Y.X.	The analysis of low carbon economy oriented industry planning-taking gongqing digiecocity as an example	Sectoral
306	388	2014	Palmas C., Jensen H., Von Haaren C., Schoner R.	Optimizing micro renewable generation for smart cities by combining solar and geothermal energy potentials a case study of the hannover region	Sectoral
307	389	2014	Wagner S., Brandt T., Neumann D.	Smart city planning - Developing an urban charging infrastructure for electric vehicles	Sectoral
308	390	2014	Requena R., Agudo A., Baron A., Campos M., Guijarro C., Puche J., Villa D., Villanueva F., Lopez J.C.	Implementing a holistic approach for the Smart City	Sectoral
309	391	2014	Voyiatzis A.G., Gialelis J., Karadimas D.	Dynamic cargo routing on-the-go: The case of urban solid waste collection	Sectoral
310	392	2014	Psyllidis A., Biloria N.	OntoPolisÂ©: A semantic participatory platform for performance assessment and augmentation of urban environments	Sectoral
311	393	2014	Dewalska-Opitek A.	Smart city concept â€“ the citizensâ€™ perspective	Cross-Sectoral
312	394	2014	Consoli S., Gangemi A., Nuzzolese A.G., Peroni S., Recupero D.R., Spampinato D.	Setting the course of emergency vehicle routing using Geolinked open data for the municipality of catania	Sectoral
313	395	2014	Fan C., Yu X., Fan H.Y.	Construction and value study of IT-based smart senior citizens' communities	Sectoral
314	396	2014	Sun C.L., Liu C., Shi D.	Construction and application of integration under IFC standard based on BIM database	Sectoral
315	397	2014	Ni D.M., Liu R.H.	Study on the enlightenment from eu smart city evaluation system	Cross-Sectoral
316	398	2014	Huang Y., Zhu R.H., Dong H.	Research on the design of smart portal for chinese cities	Cross-Sectoral
317	399	2014	Xiaoguo Y., Chuang F.	Ecological analysis of smart city based on the numerical simulation technology	Sectoral
318	402	2014	Mohammed F., Idries A., Mohamed N., Al-Jaroodi J., Jawhar I.	UAVs for smart cities: Opportunities and challenges	Sectoral
319	403	2014	Wang L.J., Ruan P.N., Li S.	Effects of information technology on rural economic development from the perspective of smart city	Cross-Sectoral
320	404	2014	Caetano F., Pitarma R., Reis P.	Intelligent management of urban garden irrigation	Sectoral
321	405	2014	Floeck M., Papageorgiou A., Schuelke A., Song J.	Horizontal M2M platforms boost vertical industry: Effectiveness study for building energy management systems	Sectoral
322	406	2014	Hong W.C.	Revelation of domestic and overseas "Smart City" construction practice to "Smart Quanzhou" construction	Sectoral
323	407	2014	Corici A., Elmangoush A., Steinke R., Magedanz T., Mwangama J., Ventura N.	Utilizing M2M technologies for building reliable smart cities	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
324	408	2014	Veeckman C., Van Der Graaf S.	The city as living labortory: A playground for the innovative development of smart city applications	Cross-Sectoral
325	410	2014	Maccani G., Donnellan B., Helfert M.	Systematic problem formulation in action design research: The case of smart cities	Cross-Sectoral
326	411	2014	Granath M., Axelsson K.	Stakeholders' views on ICT and sustainable development in an urban development project	Cross-Sectoral
327	412	2014	Chianese A., Piccialli F.	Designing a smart museum: When cultural heritage joins IoT	Sectoral
328	413	2014	Poncela J., et.al.	Smart cities via data aggregation	Sectoral
329	414	2014	Stolfi D.H., Alba E.	Eco-friendly reduction of travel times in European smart cities	Sectoral
330	417	2014	Reis P., Pitarma R., Goncalves C., Caetano F.	Intelligent system for valorizing solid urban waste	Sectoral
331	418	2014	Himmel S., Zaunbrecher B.S., Wilkowska W., Ziefle M.	The youth of today designing the smart city of tomorrow: Challenges to future mobility, energy, and city climate	Sectoral
332	421	2014	Greco I., Bencardino M.	The paradigm of the modern city: SMART and SENSEable Cities for smart, inclusive and sustainable growth	Cross-Sectoral
333	422	2014	Wang N.N., Chen R.	Discussion of the Integrated Giddied Urban Management	Sectoral
334	423	2014	Li X.Q., Zhang W., Tao C.Y., Wang Y.X.	Analysis of the characteristics of Gongqing DigiEcoCity planning	Sectoral
335	424	2014	Yu B.	Present situation and countermeasures of China's wisdom scenic area	Sectoral
336	425	2014	Campbell D., Pereira E.G., McDowell G.	Ontology driven framework for personal mhealth application development	Sectoral
337	426	2014	Doukas C., Antonelli F.	A full end-to-end platform as a service for smart city applications	Sectoral
338	427	2014	Bellavista P., Caselli F., Foschini L.	Implementing and evaluating V2X protocols over iTETRIS: Traffic estimation in the COLOMBO project	Sectoral
339	428	2014	Giovannini L., Pezzi S., Di Staso U., Prandi F., De Amicis R.	Large-scale assessment and visualization of the energy performance of buildings with ecomaps: Project SUNSHINE: Smart urban services for higher energy efficiency	Sectoral
340	429	2014	Vazquez-Salceda J., et.al.	Making smart cities smarter using artificial intelligence techniques for smarter mobility	Sectoral
341	431	2014	Amaba B.	Industrial and business systems for Smart Cities	Cross-Sectoral
342	432	2014	Sanchez L., Elicegui I., Cuesta J., Munoz L.	On the energy savings achieved through an internet of things enabled smart city trial	Sectoral
343	433	2014	Perillo G.	Smart models for a new participatory and sustainable form of governance	Cross-Sectoral
344	434	2014	Liu S., Li W., Liu K.	Pragmatic oriented data interoperability for smart healthcare information systems	Sectoral
345	435	2014	Aihara K., Imura H., Takasu A., Tanaka Y., Adachi J.	Crowdsourced mobile sensing for smarter city life	Sectoral

NO	ID	YEAR	AUTHORS	TITLE	CLASSIFICATION
346	436	2014	Li X.Q., Zhang W., Tao C.Y., Wang Y.X.	On conservation strategies for ecological green planning of Gongqing DigiEcoCity	Sectoral
347	437	2014	Wang S.-M., Huang C.-J.	User experience analysis on urban interaction and information service in smart city nodes	Sectoral
348	438	2012	Brenna M., Falvo M.C., Foiadelli F., Martirano L., Massaro F., Poli D., Vaccaro A.	Challenges in energy systems for the smart-cities of the future	Sectoral
349	440	2011	Su K., Li J., Fu H.	Smart city and the applications	Cross-Sectoral
350	441	2009	Al-Hader M., Rodzi A., Sharif A.R., Ahmad N.	Smart city components architecture	Sectoral
351	442	2011	Pal A., Bhaumik C., Shukla J., Kolay S.	Energy Information Gateway for home	Sectoral
352	443	2005	Van Den Besselaar P., Deckers D.	The life and death of the great Amsterdam Digital City	Sectoral

A.2. Reviewed Papers

TITLE:	(Not so) smart cities?: The drivers, impact and risks of surveillance-enabled smart environments
AUTHOR(S):	G. Galdon-Clavell
YEAR:	2013
VENUE:	Science and Public Policy
SUMMARY:	This paper addresses in a critical way the surveillance-enable smart environment systems that proliferating under the umbrella of smart cities. The authors intend with this study to provide a start point to future discussions about legal, social and ethical issues with policy-makers, developers and academics.
HIGHLIGHTS:	The paper highlights that: 1) the legal, social and ethical impact of smart environments are being neglected and technologies are being used in an uncritical way; 2) human-rights implications and risks of the technologies already in use should be reviewed; 3) it is necessary to step towards a more responsible and rights-based smart city development.

TITLE:	A conceptual enterprise architecture framework for smart cities: A survey based approach
AUTHOR(S):	G. Kakarontzas, L. Anthopoulos, D. Chatzakou et al.
YEAR:	2014
VENUE:	ICE-B 2014 - Proceedings of the 11th International Conference on e-Business, Part of ICETE 2014 - 11th International Joint Conference on e-Business and Telecommunications
SUMMARY:	This paper reports the results of the research project EADIC (Developing an Enterprise Architecture for Digital Cities) on an enterprise architecture for smart cities. The results showed that the more important requirements for smart cities are interoperability, usability, security, availability, recoverability, and maintainability. The paper also presents a conceptual framework based on the above-mentioned requirements.
HIGHLIGHTS:	The paper highlights that: 1) important quality properties for smart cities have been identified; 2) a conceptual framework has been proposed; 3) it is advisable to use a supporting IT organization and use Free/Open source software in order to reduce costs.

TITLE:	A framework for cloud-based context-aware information services for citizens in smart cities
AUTHOR(S):	Z. Khan S. Kiani, K. Soomro
YEAR:	2014
VENUE:	Journal of Cloud Computing: Advances, Systems and Applications
SUMMARY:	The work proposes a cloud based context-aware service framework and architecture for smart cities. The authors advocate that to have intelligent information for an effective smart urban governance it is necessary to integrate the different applications for their interaction to produce that intelligent information.
HIGHLIGHTS:	The paper highlights that: 1) citizens should collect data from the surrounding environment, and also be feed with quality contextual information; 2) the results show that the citizens' participation can help provide precise location/contextualized information, but it should be subject to a quality verification; 3) the proposed architecture has the potential to produce more awareness information regarding crimes and safety situations; 4) the results also show that the cloud-based dynamic resource provisioning of architecture meets the Quality-of-Service required.

TITLE:	A Smart City Initiative: the Case of Barcelona
AUTHOR(S):	T. Bakıcı, E. Almirall, J. Wareham
YEAR:	2012
VENUE:	Journal of the Knowledge Economy

SUMMARY:	This paper describes and analyses the transformation of Barcelona city into a smart city. It starts by overviewing the current status of the urban policy of Barcelona and its future intends. Then, it presents the existing literature about Barcelona smart city initiatives. Afterwards, the paper describes the main components of Barcelona smart city strategy – smart districts, living labs, initiatives, e-Services, infrastructures, and open data.
HIGHLIGHTS:	The paper highlights that: 1) the results reveal that Barcelona smart city strategy and its implementation are being successful; 2) cities need to proactively make partnerships between public and private institutions; 3) smart cities are grounded in three important factors – infrastructure, human capital and information; 4) the results indicate that both public and private services benefited with the smart city initiatives; 5) the main components of Barcelona smart city strategy are smart districts, living labs, initiatives, e-Services, infrastructures and Open Data; 6) the outcomes of Barcelona smart city implementation can be observed clearly.

TITLE:	A strategic view on smart city technology: The case of IBM Smarter Cities during a recession
AUTHOR(S):	S. Paroutis, M. Bennett, L. Heracleous
YEAR:	2014
VENUE:	Technological Forecasting and Social Change
SUMMARY:	The paper proposes a new approach to smart city solutions based on a strategic view of create and disseminate technologies for overcome city problems, mainly in a context of a recession. The authors developed a conceptual framework educe from recession literature and evaluate the IBM case study on smart cities with this framework.
HIGHLIGHTS:	The paper highlights that: 1) IBM has increased its profits on Smart Planet projects; 2) future research should be based on performance indicator of ICT technologies in order to perceive its impact in different actors over time; 3) in relation to ICT and stakeholders involved in the smart city solution, the ICT organization that will deliver the technology should develop a specific and appropriate solution to the reality of the city in question.

TITLE:	Advancing the Impact of Design Science: Moving from Theory to Practice
AUTHOR(S):	G. Maccani, B. Donnellan, M. Helfert
YEAR:	2014
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	This paper explores how Information Systems investigation could be conducted in the field of smart cities. The scientific community of Information Systems is trying to develop a smart city theory grounded in the knowledge maturity in this context of smart cities. The authors present a study about the information Systems research methodologies and showed the suitability of the Action Design Research (ADR) for smart cities projects.
HIGHLIGHTS:	The paper highlights that: 1) the Information Systems on smart cities should rely on seven ADR principles (Practice-Inspired Research, Theory-Ingrained Artefact, Reciprocal Shaping, Mutually influential roles, Authentic and Concurrent Evaluation, Guided Emergence and Generalized Outcomes); 2) to support the previous item the paper describes the evolution of IS research in smart cities based on a framework to see the level of maturity of the knowledge; 3) it was provided in this paper an example of the successful implementation of ADR in smart cities. We can conclude that IS research in Smart Cities needs to be DSR that recognizes that the artefact emerges from the interaction with the organizational context (i.e. local government. Design Science Research (DSR) the main focus is around designing and building innovative artefacts. Moreover, the artefact should be relevant to the solution of an unsolved and important problem systematic literature review (SLR) Action Design Research (ADR).

TITLE:	African urban fantasies: dreams or nightmares?
AUTHOR(S):	V. Watson

YEAR:	2013
VENUE:	Environment and Urbanization
SUMMARY:	The paper explores how the government of Angola used financing credit facilities offered by Chinese to upgrade the urban services and housing. The author also makes some reflections about consequences of the period previous to the post-independence, which left some African countries with several decades of stagnant development.
HIGHLIGHTS:	The paper highlights that: 1) the new urban projects were made resorting to concessionary loans that need to be paid back; 2) China is an neo-urbanization model, which is being followed and strongly promoted in Africa; 3) in Luanda, Angola, the urbanization resulted in an oversupply of housing and in a collapse of real estate values; 4) the new urbanism of Luanda raises some fundamental questions - if the new urban private sector-driven model is viable or not, if it is sustainable without state help.

TITLE:	AI Approaches to the Complexity of Legal Systems
AUTHOR(S):	F. Galindo
YEAR:	2014
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	The work makes a summary presentations of several experiences/projects of research over the last thirty years on law and ICT areas. They present methods, styles of work and researches that have allowed providing solutions to problems that are involved in relation to the topics "Law and information and communication technology (ICT)". This is made in order to find in these procedures insights that can serve other people to solve these problems in the coming years. The authors advocate that this area requires making joint efforts with law professionals who have been trained in different skills of the relationship between law and ICTs. Therefore, they consider the interdisciplinary is required for lawyers who want to develop legislation in this area. They conclude with: "the researchers are working out social and legal problems in a broad sense: Law and consensus, Values, Justice, Efficiency, Governance… and not on normative issues only".

TITLE:	Application of E-technologies for regional development: The case of Vilnius city
AUTHOR(S):	E. Zavadskas, A. Kaklauskas, A. Banaitis
YEAR:	2010
VENUE:	Journal of Business Economics and Management
SUMMARY:	The work investigates what are the major trends of e-cities development in developed countries and based on this, the study provides some general recommendations for e-Vilnius project in Lithuania. Based on the lessons learned from this study the authors have proposed a model for the development of e-Vilnius project.

TITLE:	Architectural implications of smart city business models: an evolutionary perspective
AUTHOR(S):	C. A. Mulligan, M. Olsson
YEAR:	2013
VENUE:	IEEE Communications Magazine
SUMMARY:	The paper addresses the two main systems architectures, ICT and telecommunications, for smart cities. Then the paper describes the evolution required in the system architecture to provide new and innovative smart city business models.
HIGHLIGHTS:	The paper highlights that: 1) smart cities need to handle simultaneously with environmental impact, economic growth and social evolution; 2) more research is needed in order to know which is the best architecture to integrate the ICT and telecommunication networks; 3) regulatory frameworks for data collected are necessary to know how it can be used; 4) the solutions should prevent monopolies; 5) is missing technical solutions to integrate mobile operators and internet providers; 6) the roll of human being should be taken into consideration in the creation of smart cities.

TITLE:	Assessment of Cities in Russia According to the Concept of “Smart City” in the Context of the Application of Information and Communication Technologies
AUTHOR(S):	I. Glebova
YEAR:	2014
VENUE:	Mediterranean Journal of Social Sciences
SUMMARY:	The paper addresses the concept of smart city and based on a framework makes a comparative study of the technological state of the three biggest Volga Federal Region cities (Kazan, Samara and Nizhniy Novgorod). At the end, the authors make some recommendations on how to implement a smart city.
HIGHLIGHTS:	The paper highlights that: 1) the most common difficulties in introducing new technologies in cities are related with ill-informed city-dwellers, lack of communication between city dwellers, city economic entities and local authorities, the introduction of complex technologies in the beginning of the process and insufficient learning systems; 2) to implement a smart city model it is necessary to have citizens well informed and trained, have a systematic monitoring process of the city and provide online information to local authorities when a city system fails; 3) the technologies of smart city model should be introduced step-by-step by the following order – a) smart traffic lights and smart crossroads; b) car-sharing system; c) smart municipal transport; d) smart stations; e) separate waste collection; f) equip citizens with devices to inform local authorities about city problems; g) inform citizens in advance when a new ICT will be introduced; 4) the state and municipal governments and businesses are the main drivers of smart cities; 5) the smart city approach is an effective tool to contribute to the development of city economy and environment.

TITLE:	Aveiro, Portugal: Making a Digital City
AUTHOR(S):	F. Nunes
YEAR:	2005
VENUE:	Journal of Urban Technology
SUMMARY:	This paper describes how digital cities can be made and assess the determinant factors for its implementation success or failure. In addition, it also presents a case study on the city of Aveiro, Portugal, with the objective of analysing the best practices in this area and learn with them for other cities.
HIGHLIGHTS:	The paper highlights that: 1) the Aveiro experience demonstrate that digital city promoted significant changes in habits and behaviours of both citizens and institutions; 2) the digital city model could be used as a tool for city modernization and social mobilization around a common goal; 3) an evaluation of the benefits of a digital city investment is necessary at all levels: social, economic, and environmental; 4) the effect of interrupting the project is very negative to the city because the routines are lost and the knowledge acquired needs to be rebuilt.

TITLE:	Bootstrapping smart cities through a self-sustainable model based on big data flows
AUTHOR(S):	I. Vilajosana, J. Llosa, B. Martinez et al.
YEAR:	2013
VENUE:	IEEE Communications Magazine
SUMMARY:	This work addresses why smart cities are having difficulties in taking off and proposes a method based on big data, which uses the API store concept, to make smart cities a reality. The main highlights of this work are:
HIGHLIGHTS:	1) A roadmap was designed to help smart city ecosystem grow; 2) A three-phase rollout for implementing smart cities is suggested by the authors. Where in the first phase should be implemented sensing structure and in the second and third phases, the management of the crowd-source data; 3) Introduces the concept of app store data flow models where developers could access them through APIs. 4) They also advocate the use of applications like Google maps, preferably without a license fee. 5) An open data model is also desirable but the authors do not believe that it will survive on a free and voluntary basis.

TITLE:	**Building an Integrated Service Management Platform for Ubiquitous Cities**
AUTHOR(S):	J. Lee, S. Baik, C. Choonhwa Lee
YEAR:	2011
VENUE:	Computer
SUMMARY:	The work proposes an Integrated Service Management Platform for Ubiquitous Ecological Cities in the south of Korea. The south Korea's U-ECO City initiative started in 2004 with the coordination of national-scale u-eco city development program, which was formally launched in August 2007. Under that program one u-eco city has been completed, six are in construction and eighteen are at the design stage. The U-Eco city R&D centre of South Korea presented the main key challenges to achieve the ambitious vision of u-eco city initiative, such as, service interoperability, service developer concerns (e.g. integrate own proprietary solutions), institutional resistance and supply-push instead demand-push.
HIGHLIGHTS:	South Korea is one of the front-runners in the race to deploy smarter cities, actually they are integrating ubiquitous and green technologies into the development of the smart cities. The proposed platform for the u-eco city centres is their first approach to accomplish this vision. The objective is to successfully implement one test bed for performance and interoperability analysis, to be a solid reference model for u-eco city services and serve as a u-eco city standard reference model for the rest of the world.

TITLE:	**City Information Network Construction-Discuss Based on The Idea of Intelligent City**
AUTHOR(S):	G. Gaofeng
YEAR:	2012
VENUE:	INTERNATIONAL JOURNAL ON Advances in Information Sciences and Service Sciences
SUMMARY:	This paper discusses how an information network can be deployed in the context of a smart city initiative. The aiming of this work is to build a solid foundation to construct urban information networks as a means to achieve city intelligence.
HIGHLIGHTS:	The paper highlights that: 1) the urban development model is shifting from digital track to smart city track; 2) the information networks can offer technical guarantees to the intelligent era; 3) the information networks are key technologies for realizing intelligent cities.

TITLE:	**Cityscripts: Unifying web, iot and smart city services in a smart citizen workspace**
AUTHOR(S):	A. Badii, D. Carboni, A. Pintus et al.
YEAR:	2013
VENUE:	Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications
SUMMARY:	This paper describes the CityScript project objectives, a prototype implementation and one evaluation of user experience with CityScripts prototype. The cityscripts proposes one scenario composed by Internet of Things (IoT) devices, social networks and online platforms.
HIGHLIGHTS:	The paper highlights that: 1) CityScript is a useful and flexible tool that allows to combine IoT services and people; 2) it also provides powerful features to help advanced users to develop new functionalities; 3) user and developers can deploy their own products and services; 4) the prototype evaluation showed the flexibility and intuitiveness of CityScript system.

TITLE:	**Clever urban development and circular economy**
AUTHOR(S):	W. Siming, L. Hui
YEAR:	2013
VENUE:	WIT Transactions on Information and Communication Technologies

SUMMARY:	This paper describes a smart city concept and introduces the concept of wisdom city. The authors advocate that ICT will be the foundation of a digital wisdom city and the low resource consumption is the goal.
HIGHLIGHTS:	This paper highlights that: 1) the twenty-first century will be the century of information where computer networks will be omnipresent in society; 2) the city will have an information technology platform for processing all city data; 3) the digital city of wisdom will be important for the construction of a low-carbon and developed city.

TITLE:	Competitiveness AND Sustainability: Can 'Smart City Regionalism' Square the Circle?
AUTHOR(S):	T. Herrschel
YEAR:	2013
VENUE:	Urban Studies
SUMMARY:	This paper introduces the smart city-regionalism to tackle with the conflicting agendas and policy ideals of competitiveness and sustainability concepts. The smart city-regionalism is a result of two principles: smart growth and new regionalism. These principles are used in this work as a policy-making mechanism and analytical framework. Smart growth allows to shift from a short-term and monetary perspective to a more holistic and long-term perspective. New regionalism provides the right scale for the discussion of political-economic, social and governmental agendas, where the contestation, negotiations and objections of citizens is one intrinsic characteristic of city-regional governance. Two cities, Vancouver and Seattle, have been studied to illustrate the differences in their evolution to smart city regionalism.
HIGHLIGHTS:	The paper highlights that: 1) the smartness notion of smart growth concept provides a mechanism to conciliate conflicting policy ideals and guidance in regional policy making; 2) smartness also provides an analytical framework to explore the intersection of regional scale (city) and political scale (local governance); 3) smart city regionalism offers a conceptual and scalar platform for policy making, as well as, an analytical framework for comparisons and collaborations between cities.

TITLE:	Complexity of legacy city resource management and value modeling of interagency response
AUTHOR(S):	E. Huestis, J. Snowdon
YEAR:	2011
VENUE:	IBM Journal of Research and Development
SUMMARY:	The paper proposes a maturity model for smart cities considering the cross-domain and agency-to-agency interactions in response to a city event and a system architecture to plan and optimize the resource management to an event response. In addition, the paper also proposes a method to quantify the estimate cost of alternative responses to an event in order to choose the best option.
HIGHLIGHTS:	The paper highlights that: 1) the work demonstrates the value of the combined model to assign costs to the operational relationships between operating agencies and agencies; 2) it is possible to calculate through the maturity model a dollar value to the interagency collaboration.

TITLE:	Creating More Intelligent Cities: The Role of ICT in Promoting Territorial Governance
AUTHOR(S):	G. Santinha, E. Anselmo de Castro
YEAR:	2010
VENUE:	Journal of Urban Technology

SUMMARY:	The paper addresses the role of ICT in local government of Portuguese territory.
HIGHLIGHTS:	The paper highlights that: 1) ICT are one important driver for the development of more intelligent cities; 2) the work describes the best ICTs practices and ICTs policies in Portugal; 3) the authors identified four main challenges for public policy actions, which are: increase local efficiency and foster the interaction with citizens; involve citizens in policy making and final decisions; give support to economic development; reinforce social and territorial cohesion; 4) as a final remark, the authors conclude that these challenges go well beyond technology and economy, which there is a need to change attitudes and build an sustainable and integrated policy agenda for ICTs.

TITLE:	Creating Smart-er Cities: An Overview
AUTHOR(S):	S. Allwinkle, P. Cruickshank
YEAR:	2011
VENUE:	Journal of Urban Technology
SUMMARY:	This paper reflects upon the anxieties currently surrounding their development. In particular, it investigates the suggestion that such developments have more to do with cities meeting the corporate needs of marketing campaigns than the social intelligence required for them to be smart. It draws the definitions and critical insights into smart cities from a series of papers presented at the 2009 Trans-national Conference on Creating Smart(er) Cities. They argue that cities often claim to be smart, but do not define why they are smart, they tend to be image-building and city marketing campaigns, undermining the collaborative and consensus-building aspirations of the networking paradigm. In the opinion of Holland (2008) for one city to be smart is not enough only use ICTs, it should have something more.
HIGHLIGHTS:	Holland claims that cities should follow a less neo-conservative and more neo-liberal philosophy in the construction of smart cities. He says that a city is smart because they are "…territories with a high capacity for learning and innovation, which is built in to the creativity of their population, their institutions of knowledge production, and their digital infrastructure for communication." He also notes that smart cities should progressively and seriously include people and the human capital as part of the equation, rather than believe that ICT can by itself automatically transform cities. For many of the authors there is no difference between intelligent and smart cities. We are only in a different stage of the evolutionary process to smart cities where the point of emphasis and intervention begins to shift from innovation to application, from the back-office to front-line services, and in policy terms, the emphasis also shifts from the corporate to the civic, from the market to the community, and from the bureaucratic administration of the economy to a liberal democratic governance.

TITLE:	Current trends in Smart City initiatives: Some stylised facts
AUTHOR(S):	P. Neirotti, A. De Marco, A. Cagliano et al.
YEAR:	2014
VENUE:	Cities
SUMMARY:	The paper presents a taxonomy for smarty cities based on applications domains, such as, natural resources and energy, transport and mobility, buildings, living, government, and economy and people. It provides an overview of smart city initiatives in order to know which application domains are more covered and tries to understand the influence that the economy, urbanity and demography could have in the implementation of a smart city.
HIGHLIGHTS:	The paper highlights that: 1) the economic development, urban structure and geography influence the smart city strategy; 2) the population density and congestion problems could impact the way a smart city is implemented; 3) the paper presents a conceptual framework for smart cities; 4) there is no unique definition for smart city.

TITLE:	Definition methodology for the smart cities model
AUTHOR(S):	G. Lazaroiu, M. Roscia
YEAR:	2012

VENUE:	Energy
SUMMARY:	The authors propose a smart city model, which allows based in “smart” indicators calculate the index of cities smartness. The authors advocate that the proposed model could help the local management in policy-making process and in the final decision between the different options that are on table. The model is a tool for policy-makers estimates the effects of their interventions, reducing in this way subjectivity of its decisions.

TITLE:	Design of Rapid Workflow Building Smart City System Platform Based on Intelligent Spreadsheets
AUTHOR(S):	Z. Hui, H. Kuan
YEAR:	2014
VENUE:	2014 Fifth International Conference on Intelligent Systems Design and Engineering Applications
SUMMARY:	This paper proposes a platform for smart cities. The platform is based on spreadsheets, which allow a faster development process and improve the efficiency.
HIGHLIGHTS:	The paper highlights that: 1) this development process enables a rapid construction of an integrated system platform for smart cities; 2) the deployment of applications is also fast and therefore their outcomes to costumers could be known earlier.

TITLE:	Designing next generation smart city initiatives - Harnessing findings and lessons from a study of ten smart city programs
AUTHOR(S):	A. Ojo, E. Curry, T. Janowski
YEAR:	2014
VENUE:	ECIS 2014 Proceedings - 22nd European Conference on Information Systems
SUMMARY:	The paper proposes a “Smart City Initiative Design (SCID) Framework” based on the analysis of ten cities with smart city programs. The objective is to provide a tool to design smart city initiatives.
HIGHLIGHTS:	The paper highlights that: 1) with the proposed method it is possible to have a clear and rigorous process to deploy artefacts and it is oriented to user needs; 2) the ten use cases could be also a source of information to the potential needs of the users and in this way help in the requirement specification for the framework; 3) the feedback of users showed that the framework is useful and is aligned with their practices; 4) they are necessary to better justify the choices of critical options, which are determinant to the success of smart city initiatives.

TITLE:	Developing and validating a citizen-centric typology for smart city services
AUTHOR(S):	J. Lee, H. Lee
YEAR:	2014
VENUE:	Government Information Quarterly
SUMMARY:	The paper, based on literature review of market and service science, proposes a typology focused on citizen-centric perspective for classifying smart services. The typological framework has four branches for classifying the services: mode of technology (automate–informative–transformative), purpose of service (hedonic–utilitarian), service authority (voluntary–mandatory), and delivery mode (passive–interactive).
HIGHLIGHTS:	The paper highlights that: 1) the services should be developed according with the precise needs and desires of citizens; 2) the old government functions are no longer useful and need to be updated; 3) the proposed typology provides a useful guideline for planers and developers of smart city services.

TITLE:	Developing the PlanIT valley: A view on the governance and societal embedding of u-eco city pilots
AUTHOR(S):	L. Carvalho, J. Campos
YEAR:	2013
VENUE:	International Journal of Knowledge-Based Development

SUMMARY:	The authors advocate that a framework for u-eco cities (ubiquitous and ecological cities) should comprise not only an ICT dimension, but also a social dimension. In the paper they try to prove these ideas and the associated concepts with a case study in the North of Portugal, called PlanIT Valley.
HIGHLIGHTS:	The paper highlights that: 1) u-eco cities should have the socio-technical dimensions and, as a complement, governance processes, and embed the citizens within u-eco city arena; 2) the pilot revealed that it is important to have a good balance between public and private interests; 3) the implementation of pilot could lead to a more homogeneous society and potentiate the transference of new technological solutions to other cities; 4) the host community is very important for the political governability model of the pilot; 5) it would be very important to have comparative studies of similar pilots; 6) the political control and the democratic participation of citizens in the pilot is a central question; 7) it will be important to evaluate if the innovation ecosystems need to import knowledge to feed the innovation.

TITLE:	Development of a strategic value assessment model for smart city
AUTHOR(S):	Y. Liu, J. Wei, A. Rodriguez
YEAR:	2014
VENUE:	International Journal of Mobile Communications
SUMMARY:	This paper describes smart cities in general and proposes an assessment model for smart cities called Smart City Value Chain (SCVC) model. This model provides an assessment system for a smart city. The goal of this model is to identify the areas that add value to a city and how smart technologies could be used in the different areas.
HIGHLIGHTS:	The paper highlights that: 1) the model is important because there is not a common smart city concept or a standard that everyone could follow and guide; 2) the results of this study can help city administrator, decision-makers and policy-makers build a smart city that truly improves people's quality of life in cities; 3) significant problems must be overcome such as infrastructure costs, ecological concerns and political limitations; 4) the model provides a quantitative approach to evaluate cities, which helps decision-makers in designing a smart city strategy; 5) it will be interesting and important to know what is the risk associated with each smart city feature.

TITLE:	Development of quantitative evaluation method regarding value and environmental impact of cities
AUTHOR(S):	T. Yamauchi, M. Kutami, T. Konishi-Nagano
YEAR:	2014
VENUE:	Fujitsu Scientific and Technical Journal
SUMMARY:	This paper presents a quantitative evaluation method based on the city value and on the environmental impact. The tools allow to assess the effect that ICT has on cities and its degree of smartness. To calculate the value of a city, the authors use the triple bottom: environment, social and economic concerns.
HIGHLIGHTS:	The paper highlights that: 1) the value of a city and environmental impact are contrary to each other; 2) to solve the environmental, social and economic problems cross industrial measures are needed and ICT will be more important than ever; 3) the introduction of ICTs reduces the environmental impact and also enhances the value of the city; 4) the city evaluation methods are important tools to develop sustainable cities with reduced environmental impact.

TITLE:	Digital Cities: Towards an integrated decision support methodology
AUTHOR(S):	E. Ergazakis, K. Ergazakis, D. Askounis et al.
YEAR:	2011
VENUE:	Telematics and Informatics

SUMMARY:	This paper addresses the problem of low ICT adoption in various cities and the consequences on lowering business competitiveness and poor service delivery. The objective is to explain the concept and benefits of digital cities, and propose a methodology for the development of digital cities with low ICT penetration rates.
HIGHLIGHTS:	The paper highlights that: 1) ICT services in a city are a ground for the development of knowledge; 2) for cities with high levels of ICT penetration it is easy to identify and adapt best practices to specific needs and characteristics of a city and integrate them in the overall strategy; and 3) for cities with low levels of ICT penetration, the development could proceed in four stages - collect data to establish the state of the city, estimate the city's ICT implementation needs, define possible intervention scenarios, and prioritize the initiatives required for ICT implementation.

TITLE:	Distributed, Ambient, and Pervasive Interactions
AUTHOR(S):	E. Christopoulou, D. Ringas, J. Garofalakis
YEAR:	2014
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	This paper presents a new approach to develop smart cities called Sociable Smart City. This approach is focused in specific social and cultural aspects of a city in order for people to get involved with city activities and decisions in innovative ways.
HIGHLIGHTS:	The paper highlights that: 1) a system that explores the city ICT infrastructure and the people intelligence empowers social activities and makes citizens enhance its participation in city activities and increase their sense of belonging; 2) urban social interactions are the reflection of the sociable qualities of a city; 3) the introduction of social applications potentiate the citizens' participation, develop the sense of belonging, increase citizen participation on decision making and bring people together around a common collective goal.

TITLE:	Distributed, Ambient, and Pervasive Interactions
AUTHOR(S):	I. Mulder
YEAR:	2014
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	The paper addresses the importance of the role of people in driving the cities transformation to a social smart cities with community-driven and technology-drive innovations.
HIGHLIGHTS:	The paper highlights that: 1) the main challenges smart cities face today is not technological but in creating a more participatory society capable of doing things of innovative manner. 2) to change society we need a strategy or a plan and partnerships with sustainable relationships capable of making transformation in society happen; 3) it is not easy to apply the best practices in the field to support a social smart city on a large scale scenario; 4) it is important to have a ICT infrastructure that will give support to the social innovation fabric.

TITLE:	Effects of Information Technology on Rural Economic Development from the Perspective of Smart City
AUTHOR(S):	L. Wang, P. Ruan, S. Li
YEAR:	2014
VENUE:	Applied Mechanics and Materials

SUMMARY:	This paper makes a study about the influence of information technology on the development of rural areas. This empirical study was made from the perspective of a smart city.
HIGHLIGHTS:	The paper highlights that: 1) information technologies affect the economic development of rural areas; 2) are important to support the economic development; 3) the study confirms the importance of rural informatization in the economic development.

TITLE:	**Engineering a Global City: The Case of Cyberjaya**
AUTHOR(S):	N. Yusof, J. van Loon
YEAR:	2012
VENUE:	Space and Culture
SUMMARY:	This paper addresses a Malaysian project to construct an intelligent city named Cyberjaya. The authors illustrate what happened after the materialization of the planned city. They argue that this utopian city has resulted in a sense of not belonging to its dwellers.
HIGHLIGHTS:	The paper highlights that: 1) there are different visions and expectations among planners, citizens and organizations for the social life of the city; 2) rigid zoning conduct negative social experiences because they typically have high surveillance systems; 3) exclusive spaces empty for most of the time; 4) those who are not working or are deprived of transports are subject to social isolation or exclusion; 5) Cyberjaya is considered a non-place, a place without history and identity, therefore its social life is very poor.

TITLE:	**Escaping from ancient Rome! Applications and challenges for designing smart cities**
AUTHOR(S):	T. Heo, K. Kim, H. Kim et al.
YEAR:	2014
VENUE:	Transactions on Emerging Telecommunications Technologies
SUMMARY:	The paper describes a few smart applications implemented in Korean cities and discusses the integration challenges and requirements. The authors' point out some challenges that need to be addressed to make the design of smart cities a reality.
HIGHLIGHTS:	The paper highlights that: 1) designing a smart city is not just put together a set of technologies; 2) there is a gap between technology evolution and its adoption in real systems; 3) the effective integration of city systems still remains a challenge; 4) there is a difference between the expectation and technologies knowledge of policy-makers; 5) create more prototype systems allows to evaluate the performance of such systems in real life and enhance the systems accordingly with the expected performance.

TITLE:	**Evaluation of research project on integrated management and services of urban development records, archives, and information**
AUTHOR(S):	X. An
YEAR:	2005
VENUE:	Tsinghua Science and Technology
SUMMARY:	This paper presents a study about the integration process of the management and the services of records, archives and information in a digital city.
HIGHLIGHTS:	The paper highlights that: 1) this study provides a guideline for managing digital records and archives in urban areas; 2) and therefore to have a sustainable development of digital city; 3) this study provided an analytical framework to diagnose problems.

TITLE:	**Fostering participation in smart cities: a geo-social crowdsensing platform**
AUTHOR(S):	G. Cardone, L. Foschini, P. Bellavista et al.
YEAR:	2013
VENUE:	IEEE Communications Magazine

SUMMARY:	The work studies how and to what extent crowdsensing can be used in smart cities. The authors propose a crowdsensing platform called McSense for smart cities.
HIGHLIGHTS:	The paper highlights that: 1) the simulation results showed that McSense assignment policies allow to have a good performance when a specific task is assigned.

TITLE:	From intelligent to smart cities
AUTHOR(S):	M. Deakin, H. Al Waer
YEAR:	2011
VENUE:	Intelligent Buildings International
SUMMARY:	The work gives a critical perspective of the current smart cities developments that are more concerning in image-building than in social intelligence as a tool for foster learning, knowledge transfer and capacity for building solutions. The paper advocates that the existing smart cities do not embed properly social intelligence.
HIGHLIGHTS:	The paper highlights the following aspects: 1) The attention should be shifted to social intelligence rather than from the needs of the market; 2) the role of networks of innovation and creative partnerships to support such intelligence; 3) social capital of collaborative platforms and consensus building, provide inclusive decisions making easy institutionalize civic values for the regeneration of urban regions as a self-sustainable environments; 4) an e-learning platform makes possible integrates knowledge-transfer and capacity building, allowing citizens, communities and organizations to collaborate in build consensus, competences and skills for the development and regeneration of urban regions.

TITLE:	Global initiatives for smart urban development
AUTHOR(S):	T. Kurebayashi, Y. Masuyama, K. Morita et al.
YEAR:	2011
VENUE:	Hitachi Review
SUMMARY:	This paper addresses Hitachi's participation in studies and projects concerning the development of social infrastructures and the enterprise's investigation on new technologies to improve this sort of infrastructures.
HIGHLIGHTS:	The paper highlights that: 1) the goal of the development of new social infrastructures is to foster the economical and sustainable development of cities. 2) Hitachi intends to collaborate in the construction of a framework for social infrastructures with frontrunners organizations and to participate in initiates to innovate this kind of infrastructures.

TITLE:	Improving Integration and Insight in Smart Cities with Policy and Trust
AUTHOR(S):	S. Cohen, W. Money, M. Quick
YEAR:	2014
VENUE:	Proceedings of the 4th International Conference on Web Intelligence, Mining and Semantics (WIMS14) - WIMS '14
SUMMARY:	This paper addresses the policy and trust components in the ICT infrastructures of smart cities. The authors advocate that trusted policies are fundamental for the development of a set of critical services and in the operations between smart city systems and in their maintenance.
HIGHLIGHTS:	The paper highlights that: 1) large systems should implement trusted policies to help cities manage this sort of systems; 2) it is necessary to change the city's systems into self-adapted and self-manages systems to work more effectively and autonomously.

TITLE:	Industrial and Business Systems for Smart Cities
AUTHOR(S):	B. Amaba
YEAR:	2014

VENUE:	Proceedings of the 1st International Workshop on Emerging Multimedia Applications and Services for Smart Cities - EMASC '14
SUMMARY:	This paper is one presentation of a research of IBM corporation and it is about Systems Thinking, Continuous Engineering and Internet of Things concepts and technologies. The author considers that these concepts and technologies could conduct to a successful smart city initiatives.
HIGHLIGHTS:	The paper highlights that: 1) in order to be successful it is necessary to make an interdisciplinary work with a critical analysis of best practices in the process, know the requirements, understand the engineering process and introduce risk modelling methods; 2) a smart city requires a standard platform that interconnects all its elements and a tested framework to design new smart cities initiatives.

TITLE:	**Information and communication technology and local governance: understanding the difference between cities in developed and emerging economies**
AUTHOR(S):	N. Odendaal
YEAR:	2003
VENUE:	Computers, Environment and Urban Systems
SUMMARY:	The work compares the initiatives of Brisbane in Australia and Durban in South Africa to incorporate ICT in local government (e-government).
HIGHLIGHTS:	The paper highlight that: 1) what emerges from this study, is that ICT initiatives in local government are intrinsically related to the municipality's organizational culture, its priorities and objectives and its strategic vision; 2) the presence of IT does not necessarily denote e-governance; 3) organizational integration is essential to ensure ICT actually contributes to enhance local government. In the Brisbane example they have created one central agency that drives its e-governance to achieve organizational integration; 4) the traditional hierarchical structures of municipalities are in contradiction with horizontal relations that foster the decision-making consensus; 5) given the variety of actors involved in local management, the collaboration, networking and coordinated interaction are crucial; 6) conceptual framework to evaluate ICT as outcome.

TITLE:	**Information centric services in Smart Cities**
AUTHOR(S):	G. Piro, I. Cianci, L. Grieco et al.
YEAR:	2014
VENUE:	Journal of Systems and Software
SUMMARY:	The paper proposes an information centric platform for smart city services. The proposed platform is described resorting to typical use cases, such as, administrative procedures and water management. The work is more focused in the ICT infrastructure and services technological aspects of smart cities.
HIGHLIGHTS:	The paper highlights that: 1) besides several aspects of the proposed platform have been covered, some issues still remain uncovered, such as the optimization of routing protocols and the generation of new users' requests; 2) the platform should be explored in a real context to see how the services behave in a real urban scenario.

TITLE:	**Insigma's technological innovation ecosystem for implementing the strategy of Green Smart city**
AUTHOR(S):	K. Wang, J. Chen, Z. Zheng
YEAR:	2014
VENUE:	PICMET 2014 - Portland International Center for Management of Engineering and Technology, Proceedings: Infrastructure and Service Integration

SUMMARY:	This paper presents a study on enterprise innovation systems, in particular on structure and operation process, and describes the Insigma (Insigma is an IT service provider in China) experience in building its own enterprise technological innovation ecosystem.
HIGHLIGHTS:	The paper highlights that: 1) Insigma is an example of a successful innovation ecosystem and its model could be replicated in other places; 2) in an innovation ecosystem the resources should be integrated in all innovation activities because it involves several industrial areas; 3) the authors believe that the technological integration roadmap and a market strategy for ecosystems will certainly result in the interest of customers; 4) in order to foster the green smart city the authors advice the government to do the following: - give support to industries related with technological innovation ecosystems; - and stimulate the creation of innovation ecosystems; 5) the enterprise technology innovation ecosystem paradigm is the perfect solution for the development of cities in China, but it needs policy support.

TITLE:	Integration of utilities infrastructures in a future internet enabled smart city framework
AUTHOR(S):	L. Sánchez, I. Elicegui, J. Cuesta et al.
YEAR:	2013
VENUE:	Sensors (Basel, Switzerland)
SUMMARY:	This paper proposes a new architecture for smart cities that explores the recent concepts of Future Internet. The architecture tries to take advantage of the existing ICT infrastructures to provide new services and enhance the existing services. The authors present a prototype of the proposed architecture, which has been installed in the parks of Santander city. The deployed prototype for autonomous public street lighting brings large energy savings.
HIGHLIGHTS:	The paper highlights that: 1) future Internet technologies will be the glue to integrate isolate city services into a global network, providing the ingredients to have a more efficiency management and sustainable development of cities; 2) the evaluation of prototype allows other cities to adopt a similar solution promoting the deployment of similar solutions into larger scales; 3) the results obtained with the implemented prototype seem to be very promising.

TITLE:	Integration of utilities infrastructures in a future internet enabled smart city framework
AUTHOR(S):	L. Sánchez, I. Elicegui, J. Cuesta et al.
YEAR:	2013
VENUE:	Sensors (Switzerland)
SUMMARY:	This paper proposes an architecture derived from concepts of Future Internet (FI) to overcome the challenges of creating smart cities. This architecture takes advantage of the communications infrastructures and of the infrastructures owned by city municipalities to provide enhanced and new city services. The paper also presents a prototype of the architecture for public street lighting, which has been deployed in one park of the Santander city.
HIGHLIGHTS:	The paper highlights that: 1) the Future Internet technologies provide the necessary glue to integrate all city service in one-all (holistic) solution; 2) the prototype showed important energy savings; a smart city platform implementation has been described in detail providing important lessons for large scale implementations.

TITLE:	Intelligent Cities and the Taxonomy of Cognitive Scales
AUTHOR(S):	M. Weinstock, M. Gharleghi
YEAR:	2013
VENUE:	Architectural Design

SUMMARY:	The paper deals with the definition of intelligent city, giving their own vision of what a city needs to be intelligent. The authors describe several concepts that they consider relevant or related with that subject, such as collective intelligence, consciousness, artificial intelligence, situated city, reactive/responsive city, adaptive/attentional city and self-aware city.
HIGHLIGHTS:	The paper highlights that: 1) sentience and intelligence are inseparable attributes for an intelligent city; 2) a reactive and responsive city is framed to the local characteristics (situated) and has the capability to sense changes in environment (Sentience) and respond accordingly to that changes; 3) an adaptive and attentional city is situated and responsive if it has the ability to select the best behaviour and configure its infrastructure by itself.

TITLE:	**Intelligent cities: Variable geometries of spatial intelligence**
AUTHOR(S):	N. Komninos
YEAR:	2011
VENUE:	Intelligent Buildings International
SUMMARY:	The work argues that the role of spatial intelligence, ICTs and institutional frameworks in the construction of innovations ecosystems for cities improve problem-solving capacity. Based on three case studies, the work highlights different spatial intelligence architectures: orchestration intelligence; amplifications intelligence; and instrumentation intelligence. This study helps understand the process of creating more intelligent communities and how this intelligence can be used to improve efficiency, operations and governance of cities.
HIGHLIGHTS:	The paper highlights the following aspects: 1) however, smart cities are expected to address challenges such as, competitiveness, active labour markets and environmental sustainability, the most smart city solutions have a very limited impact into these challenges; 2) this mismatch should be related with the lack of smart city solutions that target these challenges or the solution are more technological or they do not implement spatial intelligence; 3) means that currently smart cities do not have yet enough intelligence; 4) the number of digital/intelligent/smart applications/solutions have a very limited impact on the effectiveness of these major challenges facing cities; 5) major intelligent/smart city definitions stress the need of ICTs to make cities more efficient, but do not stress the need of integration among the several actors; 6) living labs could bring together all these actors and integrate them in innovative ways; 7) they finally conclude that research should focus more on architectures capable of integrating the different actors of a smart city.

TITLE:	**Knowledge spaces and places: From the perspective of a “born-global” start-up in the field of urban technology**
AUTHOR(S):	L. Carvalho, I. Santos, W. van Winden
YEAR:	2014
VENUE:	Expert Systems with Applications
SUMMARY:	This paper shows how a firm, Living PlanIT, which sells smart city solutions, explores and exploits the innovation aspects of a city. The authors advocate that the interaction of different places and knowledge-based cities can allow the development of technology resources, search, experimentation, market formation and have societal legitimation.
HIGHLIGHTS:	The paper highlights that: 1) different knowledge of cities and geographies are important for firms like Living PlanIT to develop a smart city solution; 2) the link between knowledge city assets and its functions is important and deserves more research attention; 3) firms like PlanIT could play an important role in the linkage of territories; 4) knowledge rich cities have higher diversity levels and are more innovative, and therefore offer more sustainable smart city projects; 5) cities branding have more facilities in legitimize the introduction of new technologies, influence decision makers and obtain resources.

TITLE:	**Local governments online and the role of the resident: Government shop versus electronic community**
AUTHOR(S):	J. Steyaert
YEAR:	2000

VENUE:	Social Science Computer Review
SUMMARY:	The work explores the different ways Internet can be used by municipalities to interact with their residents.
HIGHLIGHTS:	The paper highlights that: 1) the authors conclude that municipalities have an important role in the everyday life of their residents and play also an important role in the future information society; 2) the municipalities use the Internet only to offer municipalities' services to residents, seeing them only as customers, as one-way information; 3) being neglected by municipalities, the web sites with services related to political roles of the resident as a voter and citizen, thus compromising local democracy in the future.

TITLE:	Mapping Smart Cities in the EU
AUTHOR(S):	Manville, Catriona Cochrane, Gavin Cave, Jonathan Millard, Jeremy Pederson, Jimmy Kevin Thaarup, Rasmus Kåre Liebe, Andrea Wissner, Matthias Massink, Roel Kotterink, Bas
YEAR:	2014
VENUE:	Report - www.europarl.europa.eu
SUMMARY:	This report provides an overview on smart cities in the European Union (EU) and makes an analysis of the Europe 2020 smart city initiatives.
HIGHLIGHTS:	The report highlights that: 1) Most Smart City initiatives are still in the early phases of development, but the larger cities tend to be the most mature (with at least one fully launched or implemented initiative); 2) The most common of the six characteristics defined in Chapter 2 are those associated with pan-European public goods problems – Smart Environment and Smart Mobility, present in 33% and 21% of initiatives respectively. Each of the other four characteristics (governance, economy, people and living) is addressed in approximately 10% of the Smart Cities, reflecting specific local strengths or weaknesses; 3) Some characteristics are likely to be found in combination with others, such as Smart People and Smart Living. 4) The objectives of the Smart City initiatives are generally aligned with those of city innovation and development strategies and the overarching Europe 2020 targets. 5) The characteristics of Smart City initiatives also reflect the actual situation of the city or country. 6) The match among different objective levels (Europe 2020, Smart City strategies and specific Smart City initiatives) is only approximate, indicating that Europe 2020 serves to stimulate and harmonise local action, but that other factors give each Smart City a unique flavour; and 7) Most initiatives aim to contribute towards smart, sustainable and inclusive growth. Environmental issues and green solutions appear to be the principal concern; nearly 50% of sampled initiatives address environmental problems through improved energy efficiency in buildings or smarter city transportation options.

TITLE:	New approach for environmental future city created by ICT: Sustainable city network
AUTHOR(S):	M. Kutami, M. Takeno, H. Ioka
YEAR:	2014
VENUE:	Fujitsu Scientific and Technical Journal
SUMMARY:	This paper proposes a new approach to achieve a smart city, called Sustainable City Network. This new approach resorts to ICT to create collaborative networks between cities, towns and villages. The authors show the results obtained in studies on environmental fields. They advocate that from the environmental perspective several problems could be solved in areas such as traffic, medical and agriculture.
HIGHLIGHTS:	The paper highlights that: 1) it is important to link cities and towns or villages with different characteristics to optimize resources like energy, traffic and buildings; 2) ICT is a useful tool to monitor, visualize, analyse and optimize the flow of resources, in particular the cloud, big data and powerful processing technologies; 3) it is necessary to design an evaluation method for environmental impact and effects of introducing ICTs; 4) to accomplish the sustainable city network a linkage between different industries domains and between national and local governments is needed.

TITLE:	Organizational Communication and Sustainable Development
AUTHOR(S):	O. Ercoskun
YEAR:	2010

VENUE:	Organizational Communication and Sustainable Development: ICTs for Mobility
SUMMARY:	This paper addresses the eco-tech (ecological and technological) city approach as a means to have sustainable small cities in the globalized world. The authors also present the pros and cons of the use of ICTs in cities.
HIGHLIGHTS:	The paper highlights that: 1) the incorporation of ICT technologies by green urban plans and design strategies can result in more progressive, innovative and sustainable cities.

TITLE:	Physical–digital integration in city infrastructure
AUTHOR(S):	D. Gann, M. Dodgson, D. Bhardwaj
YEAR:	2011
VENUE:	IBM Journal of Research and Development
SUMMARY:	This paper describes how the integration of the physical infrastructures and digital technologies could be done. They argue that the technological innovation is fundamental to the development of cities in order to become smarter. The content of the paper is based on case studies of IBM and the construction company Laing O'Rourke, two companies deeply involved with digital technologies and their integration.
HIGHLIGHTS:	The paper highlights the following aspects: 1) They propose a suite of tools called "innovation technology" (IvT) that enables the virtualization of systems and services; 2) it is necessary to have more research on system-of-systems integration; 3) the capacity of technologies represent plans and options virtually, allows a better comprehension of the design strategy; 4) developed cities with several vintages of infrastructures have the potential risk of mismatch between lifecycle duration of its physical assets; 5) innovation problems are different according to industrial and political history, culture, geography, topology and local, national and international policies; 6) It poses the following questions: "How citizen-driver innovation will occur at the system-of-systems level?" "How will performance be measured?" These questions were not answered in this paper, only identified.

TITLE:	Programming environments: environmentality and citizen sensing in the smart city
AUTHOR(S):	J. Gabrys
YEAR:	2014
VENUE:	Environment and Planning D: Society and Space
SUMMARY:	The paper explores how smart cities projects can be understood through the distribution of governance and with environmental technologies, by resorting to sensor-based ubiquitous computing and to mobile devices to achieve sustainability.
HIGHLIGHTS:	The paper highlights that: 1) the vision discussed in the paper could be seen as a technical solution to political and environmental issues of several smart city projects; 2) smart city projects incorporate the monitoring, economizing and a vision of digital economic growth, these sort of cities produce ways of life that need to be oriented to sustainability goals like productivity and efficiency; 3) smart city projects should give attention to the ways of life as a way to promote sustainable cities.

TITLE:	Research on System Development of Smart City
AUTHOR(S):	Y. Zhu, J. Zuo
YEAR:	2013
VENUE:	Advanced Materials Research
SUMMARY:	The paper introduces a method for systematic smart city development. The introduced method for a systematic construction of smart cities is composed by a system architecture of smart city, a soft environment, an urban dimensional model, an indexed evaluation, a causal diagram, and an evaluation flow chart.
HIGHLIGHTS:	The paper highlights that: 1) the big challenge of cities is how to operate efficiently huge amounts of data; 2) how to deal with big data in smart cities operation, what the related mechanisms needs further study.

TITLE:	Research on Technology System of Smart Residential District in China
AUTHOR(S):	Wang, Bo, Gao, Yuan, Shi, Qing, Hong, Zheng, Yu, Hang Sun, Zhi Guo
YEAR:	2014
VENUE:	Applied Mechanics and Materials
SUMMARY:	This paper proposes a technology system based on Internet of Things, could computing and other ICT technologies to be deployed on smart residential districts of China.
HIGHLIGHTS:	The paper highlights that: 1) the proposed technology system for Chinese residential district was presented in a systematic way and could be used as a guide to construct smart residential district; 2) the system will be implemented in four main districts of China.

TITLE:	Rule-Based Model for Selecting Integration Technologies for Smart Cities Systems
AUTHOR(S):	C. Orłowski
YEAR:	2014
VENUE:	Cybernetics and Systems
SUMMARY:	The paper proposes an information technology integration model for smart cities and illustrates the importance of integration technologies in designing smart cities systems.
HIGHLIGHTS:	The paper highlights that: 1) the selection of the integration technologies is important because it helps the cooperation and collaboration between experts of different fields; 2) the combinations of knowledge and experience should drive the design of such models; 3) the explanation of the model was made resorting to linguistic methods.

TITLE:	SCRAN: The Network
AUTHOR(S):	P. Cruickshank
YEAR:	2011
VENUE:	Journal of Urban Technology- Special Issue: Creating Smart-er Cities
SUMMARY:	This paper addresses the SCRAN's model of the triple helix for the smart cities venture and identifies the communications needs and the requirements of the network that facilitate the knowledge transfer among cities. SCRAN (Smart Cities (inter)Regional Academic Network) is a venture composed by a network of universities and cities.
HIGHLIGHTS:	The paper highlights that: 1) the methodology adopted to develop SCRAN as a network underlies on the organizations web-services, the work is commissioned from business sector and the governance of the development process; 2) in the triple helix the university is no longer seen as a top-down exercise, on the generation of human capital, but rather a bottom-up exercise in the creation of human capital regulating the development of eGov services; 3) the triple helix is no longer about the production of knowledge economy, but in the creation of human capital which is reached with learning communities.

TITLE:	Situated Engagement and Virtual Services in a Smart City
AUTHOR(S):	S. Hosio, J. Gonçalves, H. Kukka
YEAR:	2014
VENUE:	2014 IEEE 7th International Conference on Service-Oriented Computing and Applications

SUMMARY:	The paper describes three new technological services (situated kiosks, sound-based resource discovery and 3D-model) currently being deployed in Oulu, Finland, for pursuing their open ubiquitous vision of a city, a city with permanent ubiquitous services for the use of its dwellers.
HIGHLIGHTS:	The paper highlights that: 1) smart environments must first provide value to citizens and then to research community; 2) the authors advocate a progressive smart community that gives voice to the citizens about the environment they want; 2) developing smart cities is far away of being only a matter of engineering aspects; 3) the introduction of new artefacts should takes into account what they are made for and mainly for whom they are made; 4) the smart city implementations should be made for humans and not only because of fashion or marketing reasons.

TITLE:	Six ages towards a learning region - a retrospective
AUTHOR(S):	N. Longworth, M. Osborne
YEAR:	European Journal of Education
VENUE:	2010
SUMMARY:	The paper explores learning cities and learning regions terms as a result of lifelong learning concept used for the economic, social and environmental development of cities. The authors believe that learning is the basis of intelligence, smartness, cleverness, creativity, innovation and knowledge. Therefore, they argue that other approaches are only a parcel of the holistic view of a learning region.
HIGHLIGHTS:	The paper highlight that: 1) have been a shift at the work paradigm in the late 20th century - era of education and training, which now has given rise to the new era of lifelong learning, in which the ICT tools are employed to motivate and cover everyone in a city. These cities will be the frontrunners in a globalised world. 2) A competent use of learning region approach in a city leads to all stakeholders be mobilised to participate in the creation of new city services.

TITLE:	Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation
AUTHOR(S):	H. Schaffers, N. Komninos, M. Pallot et al.
YEAR:	2011
VENUE:	The Future Internet SE - Lecture Notes in Computer Science
SUMMARY:	The paper explores the smart city concept in the light of open environments and user drive innovation for enable new services. It addresses the challenges that cities will face in the exploration of the opportunities offered by Future Internet and Living Lab-innovation ecosystems. Discusses how methodologies of Future Internet experimentation and Living Labs could constitute the innovation ecosystems of smart cities and also presents examples of such ecosystems. The paper emphasizes how the diverse set of resources that constitute the ongoing research on smart cities can be made open and accessible for users and developers. They identified two layers of collaboration for sharing resources. One layer is focused on research and innovation process of the existing resources and the other layer addresses the urban innovation system. They conclude that the type of collaboration frameworks need further investigation and also need development and pilot projects. The first examples of resource sharing make it available were the living labs facilities for user communities develop and validate new services concepts for smart cities (e.g. Smart Santander and ELLIOT projects).

TITLE:	Smart Cities and Their Smart Decisions: Ethical Considerations
AUTHOR(S):	D. Bianchini, I. Avila
YEAR:	2014
VENUE:	IEEE Technology and Society Magazine

SUMMARY:	This paper addresses some possible negative consequences or impacts of smart cities deployment around the world and based on that proposes an ethical framework for the use of "ICTization" in cities.
HIGHLIGHTS:	The paper highlighted that: 1) it is of great importance clearly identify the hidden risks behind decisions, which are only justified with technical arguments; 2) it is necessary to guarantee independent and equal access to justice and administration services; 3) it is crucial to avoid the manipulation of information delivered, because this will certainly distort the notion of reality; 4) foster the participation of citizens and organizations in the decision-making process; 5) it is fundamental to introduce the ethical dimension at all decision levels, not only in the decision moment but also during operation; 6) biased information could overshadow and jeopardize the benefits of smart cities.

TITLE:	Smart Cities as Sustainable Innovation Actors - Insights from and for Portugal
AUTHOR(S):	Away, Take
YEAR:	2014
VENUE:	www.casi2020.eu
SUMMARY:	This paper shows how a firm, Living PlanIT, which sells smart city solutions, explores and exploits the innovation aspects of a city. The authors advocate that the interaction of different places and knowledge-based cities can allow the development of technology resources, search, experimentation, market information and have societal legitimation.
HIGHLIGHTS:	The paper highlights that: 1) different knowledge of cities and geographies are important for firms like Living PlanIT to develop a smart city solution; 2) the link between knowledge city assets and its functions is important and deserves more research attention; 3) firms like PlanIT could play an important role in the linkage of territories; 4) knowledge rich cities have higher diversity levels and are more innovative, and therefore offer more sustainable smart city projects; 5) cities branding have more facilities in legitimize the introduction of new technologies, influence decision makers and obtain resources.

TITLE:	Smart Cities in Europe
AUTHOR(S):	A. Caragliu, C. Del Bo, P. Nijkamp
YEAR:	2011
VENUE:	Journal of Urban Technology
SUMMARY:	The work presents a definition of the smart city concept and identifies the main factors that determine the good performance of smart cities. They argue that, to be smart, a city needs investments in human and social capital, traditional transport, ICT feed sustainable development and quality of life, allowing for a more efficient management of resources, through participatory governance. They showed evidence of a positive association between urban wealth and the presence of creative professional, multimodal accessibility, the quality of transportation networks, diffusion of ICTs and quality of human capital. They argue that these positive association clearly define a policy agenda for smart cities. However, over time these variables deteriorate. Hence, there is a continuous challenge to update them to ensure a sustainable development for cities.

TITLE:	Smart cities in perspective – a comparative European study by means of self-organizing maps
AUTHOR(S):	K. Kourtit, P. Nijkamp, D. Arribas
YEAR:	2012
VENUE:	Innovation: The European Journal of Social Science Research

SUMMARY:	This paper makes a study of nine European cities belonging to the SCRAN network (SmartCities (inter) Regional Academic Network) and analyses their position according with performance indicators of smartness. The authors try to provide an analytical framework for identifying the cities in Europe with more creative potential.
HIGHLIGHTS:	The paper highlights that: 1) cities have to explore their local characteristics to be distinct, but also have to operate in a global network, where they can learn from each other; 2) the space-time analysis used in the paper is very useful to see the relative position of cities; 3) most cities have converged over time becoming more similar, only few of them became more distinct.

TITLE:	Smart cities in the new service economy: building platforms for smart services
AUTHOR(S):	A. Anttiroiko, P. Valkama, S. Bailey
YEAR:	2013
VENUE:	AI & SOCIETY
SUMMARY:	This paper deals with public services and platforms for smart cities. The authors identify the key organizational dimensions of smart services and deployed a conceptual model for smart service platforms (e-platforms) where the technology is the means to it and has the objective of increasing social creativity.
HIGHLIGHTS:	The paper highlights that: 1) the smart city concept has potential to link new technologies, social systems and environmental impact, but requires an holistic and integrative approach to became reality; 2) some kind of platform is necessary to integrate and manage smart services; 3) to properly conceptualize a smart city it is important to take into account not only the technology, but also the human capital and the ecological context, in order to add maximum value to the city.

TITLE:	Smart cities of the future
AUTHOR(S):	M. Batty, K. Axhausen, F. Giannotti et al.
YEAR:	2012
VENUE:	The European Physical Journal Special Topics
SUMMARY:	The work presents the goals, opportunities and challenges addressed by the FuturICT project (European Project). Then introduces the state-of-the art of smart cities, namely: key themes, understanding smart cities, planning smart cities, some exemplars and scenarios for smart city. Afterward it describes the project approach to smart cities by identifying the essential tensions in this area, key themes, their project proposals for smart cities and demonstrators.The work ends with a description of the project strategy regarding the relevant disciplines and fields, key references and patents, demonstrator outcomes and ethical issues and with the expected impacts on science, technology and competitiveness, and society.
HIGHLIGHTS:	The paper highlights that: 1) smart cities represent a paradigm shift from a world based on energy and materials to one based on information; 2) the first major step towards smart cities which is the most obvious is the development of information infrastructure that underpins the city through distributed computing and networks available to everyone with devices that can access such infrastructure; 3) as an obvious spin-off from such service delivery, the data that is routinely collected is now being used to make cities smarter over different spatial and temporal scales; 4) we are also realising that for the first time that we stand at a threshold in devising a new science of human behavior and in our own domain, this will be a science of spatial behavior.

TITLE:	Smart cities, smart places, smart democracy: Form-based codes, electronic governance and the role of place in making smart cities
AUTHOR(S):	D. Walters
YEAR:	2011
VENUE:	Intelligent Buildings International

SUMMARY:	This paper advocates that if the right policies and implementation tools are put in place in the urban design together with the e-governance structure of municipality and its particular culture, it is possible to achieve a good balance between physical and virtual worlds.
HIGHLIGHTS:	The paper highlights that: 1) the pervasive characteristic of data and services could help to bind disperse and separate communities; 2) the massive deployment of ICT technologies with surveillance and invisible networks systems could threaten citizens; 3) it is important to provide locally focused information; 4) the implementation of truly smart communities may be only a matter of political decision rather than a technical one.

TITLE:	Smart cities: the state-of-the-art and governance challenge
AUTHOR(S):	M. Deakin
YEAR:	2014
VENUE:	Triple Helix
SUMMARY:	The paper presents an advanced Triple Helix model to illustrate that cities are smart when ICTs developments consider the society needs in terms of environmental culture, ecology and participatory governance to add real value to cities.
HIGHLIGHTS:	The paper highlights that: 1) models are required to develop ICT technologies and to measure their value to community; 2) the advanced Triple Helix can represents the capacity of the embed intelligence, cultural attributes and environmental culture of a city; 3) advanced Triple Helix serves as a mean to cultivate the ICT developments.

TITLE:	Smart city and the applications
AUTHOR(S):	K. Su, J. Li, H. Fu
YEAR:	2011
VENUE:	2011 International Conference on Electronics, Communications and Control (ICECC)
SUMMARY:	This paper explores the current concept of smart city in the research literature, explains how smart city and digital city concepts are related and makes some comments about the influence of developing a smart city in China.
HIGHLIGHTS:	The paper highlights that: 1) a smart city model represents a good opportunity for China to be well positioned in the smart planet; 2) to have economic and social development it is necessary to increase the investment in material, technical, and personal infrastructure; 3) during the deployment process some priorities like smart transport or smart should be planned in order to have a more comprehensive interconnection and intelligence between these elements; 4) the development of smart city is based on the Internet of Things.

TITLE:	Smart city architecture: A technology guide for implementation and design challenges
AUTHOR(S):	R. Wenge, X. Zhang, C. Dave et al.
YEAR:	2014
VENUE:	China Communications
SUMMARY:	This paper presents a data oriented architecture for smart cities and discusses the design challenges related with its implementation, giving some useful insights on how the smart cities could be deployed.
HIGHLIGHTS:	The paper highlights that: 1) its architecture with 6 layers (Events, Domain Services, Support, Storage and Vitalization, Data Transportation, and Data Acquisition) can cover all the aspect of a smart city deployment; 2) the critical factors for the successful implementation of smart cities are security and administration of infrastructure.

TITLE:	Smart city as an innovation engine: Case Oulu
AUTHOR(S):	M. Rantakokko
YEAR:	2012

VENUE:	Elektrotehniski Vestnik/Electrotechnical Review
SUMMARY:	This paper describes the Oulu experience in several aspects of smart city development, such as technologies, business models, partnership and innovations and identifies the strategic steps to maintain Oulu on the top of innovation centres. The authors advocate that the key of the success for a sustainable development is a seamless collaboration between all partners of the innovation process through a PPPP - Private-Public-People-Partnership.
HIGHLIGHTS:	The paper highlights that: 1) the city of Oulu is a forerunner in the race for smart cities; 2) citizens play a fundamental role in the innovation process; 3) the innovation feature and responsiveness to changes ensures Oulu city be on the top of smart cities.

TITLE:	Smart city concept – the citizens' perspective
AUTHOR(S):	A. Dewalska-Opitek
YEAR:	2014
VENUE:	Communications in Computer and Information Science
SUMMARY:	This paper addresses the implementation of a smart city concept in Poland. It includes the perspectives of its citizens in an important issue of smart city implementation, the smart mobility and their future vision in relation to smart city.
HIGHLIGHTS:	The paper highlights that: 1) the world smart cities rankings indicates that not only large metropolis could be smart, but also medium-sized cities could successfully implement this concept; 2) the enquiries made to citizens indicate that smart city is a not well-known concept; 3) the most important elements for citizens are: quality of life, efficient management of urban space, good public transportation, and communications; 4) the analysis of the collected data point out to an gap in what citizens knows about smart city and what is in reality a smart city.

TITLE:	Smart City Development Level Assessment for Tianjin Using AHP and Gray Comprehensive Evaluation
AUTHOR(S):	L. Fei
YEAR:	2012
VENUE:	International Journal on Advances in Information Sciences and Service Sciences
SUMMARY:	The paper proposes an evaluation model to measure the smartness levels of Tianji city. To measure the city smartness the evaluation model uses as indicators the level of informatization, innovation capability and resource utilization.
HIGHLIGHTS:	The paper highlights that: 1) if the R&D funds from government are increased, this can conduct and stimulate more investment for R&D from society and industry; 2) the investment in information infrastructures could accelerate the implementation of smart city model; 3) the deployment of a resource sharing platform optimizes the utilization of resources.

TITLE:	Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems
AUTHOR(S):	S. Zygiaris
YEAR:	2012
VENUE:	Journal of the Knowledge Economy

SUMMARY:	This paper addresses the smart city related concepts and how these concepts could be applied to green innovation, broadband economy and innovative ecosystems. Then, it proposes a reference model for building a smart city vision composed by seven layers.
HIGHLIGHTS:	The paper highlights that: 1) cities should tailor their own smart city project by considering that certain innovation ecosystems provide a more sustainable future; 2) cities are the most important places for a sustainable planet; 3) city planners should have into consideration the design of green and sustainable innovations; 4) the reference model could be used by city planners to define the conceptual layout of the city and describe the innovations aspects of each layer; 5) the reference model can be also used to evaluate and compare cities and identify complementarities and drawbacks in the city plan; 6) the conceptual model can be utilized to provide a better understanding of the city model and to optimize the investments.

TITLE:	Smart Ideas for Smart Cities: Investigating Crowdsourcing for Generating and Selecting Ideas for ICT Innovation in a City Context
AUTHOR(S):	D. Schuurman, B. Baccarne, L. De Marez
YEAR:	2012
VENUE:	Journal of theoretical and applied electronic commerce research
SUMMARY:	In this work the authors explore the strengths and weaknesses of crowdsourcing method for the creation of new ideas and selection of the best one. They also define the smart city concept has a more user-centred evolution of the city-concepts (i.e. digital cities, intelligent cities or ubiquitous cities), which are more technological-centred in nature. They compared a crowdsourcing case study, an online platform against a group of external experts and the comparison indicates that crowdsourcing has a long list of benefits.
HIGHLIGHTS:	The paper highlights that: 1) besides crowdsourcing appears to be very useful, it should be used and combined with other involvement approaches and within living labs.

TITLE:	Smart models for a new participatory and sustainable form of governance
AUTHOR(S):	G. Perillo
YEAR:	2013
VENUE:	WIT Transactions on Ecology and the Environment
SUMMARY:	This paper explores the main features that a smart city should include during its development. The author advocates that innovation must be present and it is an essential element for city development, however, its implementation is not a simple technological challenge but above all a social one.
HIGHLIGHTS:	The paper highlights that: 1) smart models must create a multi-sustainable society, but the required transformations are numerous and complex; 2) a smart model is not a mathematical sum of smart features; 3) policies, technologies and projects must have a common goal, otherwise they will risk compromising the potential of smart city model; 4) smart models offer a win-win solution because the aim is to guarantee quality of life to citizens and optimize resources, and assure sustainability.

TITLE:	Smart networked cities?
AUTHOR(S):	E. Tranos, D. Gertner
YEAR:	2012
VENUE:	Innovation: The European Journal of Social Science Research

SUMMARY:	The paper criticizes the lack of a global inter-urban approach in the smart city conceptual framework. The authors justify why the smart city framework needs to incorporate the global urban interdependencies and give some policy examples.
HIGHLIGHTS:	The paper highlights that: 1) the importance of inter-urban dependencies in the smart city agenda; 2) it is not possible to develop a smart strategy without knowing the city's relative position in global urban networks; 3) a smart city policy framework cannot be realized unless its inter-urban dependencies are taken into account; 4) besides the importance that hardware has in the smart city model, it is not sufficient, the human capital is of equal importance and the cities should compete at a global scale. 5) issues like equity and inclusion are also important for the agenda of a smart city; 6) the urban policy should include in its agenda aspects regarding connectivity, performance, and flow; 7) the smart city model should strength the city-to-city communication and collaboration.

TITLE:	Smarter Cities and Their Innovation Challenges
AUTHOR(S):	M. Naphade, G. Banavar, C. Harrison et al.
YEAR:	2011
VENUE:	Computer
SUMMARY:	The paper addresses the innovation challenges of cities to conduct planning, management and operations innovations to transform cities into smart environments. The authors present urbanization, economic growth, technological progress and environmental sustainability as the main drivers for the need of smart cities. The transformation of cities into smarter spaces involves a set of steps, including assessment of its needs and innovation opportunities, the integration of public and private systems to achieve effectiveness, improvement of urban business processes by having innovative processes in planning, management and operations. The authors give some examples of different cities in size, geography and economy, which are in transformation process to smart cities (Rio de Janeiro - Brazil, Dubuque - Iowa, Bornholm - Denmark, Songdo IBD - South Korea).
HIGHLIGHTS:	The paper highlights that: 1) an ideal smart city as a closed loop of tightly interconnected systems. Where the systems are characterized by their function in the overall city system: sensing, information management, analytics and modelling and influencing outcomes.

TITLE:	Smartmentality: The Smart City as Disciplinary Strategy
AUTHOR(S):	A. Vanolo
YEAR:	2013
VENUE:	Urban Studies
SUMMARY:	The paper makes some theoretical reflections about the current discourse of smart city in European Union and presents as a case study the Italian's cities politics for smart cities.
HIGHLIGHTS:	The paper highlights that: 1) the reason why the smart city strategy is so in vogue in Europe is because of the availability of financial funds, the will of private sector to invest in smart city projects and the good image transmitted by smart cities as liveable, clean, technological advanced cities; 2) the smart city discourse requires a new power geometry in relations between all the partners and citizens and produce knowledge and its circulations to all citizens; 3) the deployment of a system to measure the cities' performance; 3) there are two dangers in the implementation of smart cities: the specific and personal objectives, strategies, ideologies and political interests could be present as natural approaches of smart cities; and have a restrict vision based on a technology-centric vision for implementing the smart solutions; 4) the need to bring the smart city subject into the political arena to discuss the different choices.

TITLE:	Special Issue on Smart Applications for Smart Cities - New Approaches to Innovation: Guest Editors' Introduction
AUTHOR(S):	H. Schaffers, C. Ratti, N. Komninos
YEAR:	2012
VENUE:	Journal of theoretical and applied electronic commerce research

SUMMARY:	This special issue illustrates the social benefits that smart applications could bring to cities, explores how they can be used to innovate processes and shows how they are closely related with urban development. That issue argues that the development of smart cities should be driven by citizens and organizations (bottom-up approach) instead of being driven by governments' strategies/plans (top-down approach). The governments should just have the role of mediators, putting on the same table all interested partners.
HIGHLIGHTS:	The special issue highlights that: 1) the smart city concept is an urban development strategy, which focus its attention on how ICT could be used to enhance the lives of citizens; 2) people are the innovators agents and cities should be open environments; 3) collaboration platforms, embedded systems, open data and semantic web technologies will enable new waves of innovation conducted by creative communities and through the collaboration of the collective intelligence of populations; 4) smart apps are programs, which enable a group of actors (city, community, citizens) to collaboratively address a set of city problems in a more intelligent and efficient way; 5) the overlapping of technologies in the last 20 years allowed the creation of new smart city applications, enabling this way the creation of cities with more intelligence and new forms of interaction between the different city actors; 6) living labs and other participatory innovation models allow to understand the gap between the technology of Future Internet and the smart applications of cities; 7) the integration of the methodology frameworks from social sciences and the smart applications in living lab environments is a very promising research area for the next years.

TITLE:	Special Issue on Smart Cities and the Future Internet in Europe
AUTHOR(S):	N. Komninos, M. Pallot, H. Schaffers
YEAR:	2012
VENUE:	Journal of the Knowledge Economy
SUMMARY:	This special issue on smart cities and the future Internet in Europe of the Journal of the Knowledge Economy aims to know how European cities are developing their strategies towards the transformation on smart cities. This transformation relies mainly on advanced network infrastructures, Internet applications and in the engagement of open innovation ecosystems. In this special four smart city case studies and two papers with transversal issues are investigated in terms of smart city strategy and policies related with how Future Internet are being used to socio-economic development of cities.
HIGHLIGHTS:	The special issue highlights that: 1) there few case studies of smart cities strategies and their outcomes; 2) there is not a clear vision how smart cities are being implemented in practice, what are the policies and strategies to explore ICT infrastructures.

TITLE:	Stakeholder Adoption of E-Government Services
AUTHOR(S):	V. Sridhar, K. Sridhar
YEAR:	2011
VENUE:	Stakeholder Adoption of E-Government Services: Driving and Resisting Factors
SUMMARY:	The paper presents a comparative study on the digital development of Indian cities with +35 million inhabitants. The indicators used in this study were e-government services and IT strategy.
HIGHLIGHTS:	The paper highlights that: 1) larger cities are better prepared to become smart cities than smaller cities with less than 10 million inhabitants.

TITLE:	Stakeholders' views on ICT and sustainable development in an urban development project
AUTHOR(S):	M. Granath, K. Axelsson
YEAR:	2014
VENUE:	ECIS 2014 Proceedings - 22nd European Conference on Information Systems

SUMMARY:	The aim of this paper is to make a critical analysis on the ICT visions and meanings that different stakeholders have in an urban development project. The authors argue that understanding how ICT is spoken by the different stakeholders in the planning phase of urban development makes it possible to incorporate these visions and how they interoperate in the design and development process of urban areas.
HIGHLIGHTS:	The paper highlights that: 1) there are different ICT visions and languages on a policy level and in practice. At a policy level, ICT is spoken in terms of social and ecological sustainability, and in practice the economic and ecological are the most important factors to have a sustainable development; 2) the above item indicates that the stakeholders give different roles to ICT and, therefore, the discourse is not the same; 3) when the technology is taken for granted and black-boxed this conducts to naïve conceptions of what characterizes ICT and how it can be used for different purposes and contexts; 4) there is a high risk that smart cities initiatives only becomes an economic goal without concerns with the sustainability issue; 5) the lack of discussion on the use of ICT in different contexts could result in counterproductive ICT solutions that are not sustainable; 6) there is a need to have more discussions on how ICT could contribute for a more sustainable urban development.

TITLE:	Study on the Enlightenment from EU Smart City Evaluation System
AUTHOR(S):	D. Ni, R. Liu
YEAR:	2014
VENUE:	Applied Mechanics and Materials
SUMMARY:	This paper proposes an evaluation system for medium-sized (100000-500000 population) EU smart cities.
HIGHLIGHTS:	The paper highlights that: 1) the development level of smartness in EU cities is not balanced and has big discrepancies; 2) to have a sustainable development, cities need smart mobility, smart people and quality of life; 3) the level of development inside the EU cities is not the same in all of its regions.

TITLE:	Sustainable development and resilience of communities - Indicators for city services and quality of life
AUTHOR(S):	Technical Committee, 268
YEAR:	2013
VENUE:	
SUMMARY:	This document briefly describes the ISO international standard on city indicators (ISO 37120). The standard provides indicators to measure the city performance to improve citizen's quality of life and sustainability.
HIGHLIGHTS:	The document highlights that: 1) indicators are quantitative, qualitative or descriptive measurements with a set of definitions and methodologies; 2) the standard can be used any city, municipality or local government to measure its performance in a comparable and comparable form, independently of its size, location or level of development; 2) the standard also could help to guide policy, planning and management of the city across all stakeholders. 3) some standard benefits - more effective governance and services, for benchmarking and targets, help policy makers and city managers, learning tool, recognition in international entities, a framework for sustainability planning, transparency and open data.

TITLE:	Systematic problem formulation in action design research: The case of smart cities
AUTHOR(S):	G. Maccani, B. Donnellan, M. Helfert
YEAR:	2014
VENUE:	ECIS 2014 Proceedings - 22nd European Conference on Information Systems

SUMMARY:	The research project present in this paper proposes a smart city maturity model, the project is being conducted by Dublin city and Intel corporation. The paper explores the research methodology used in this study, i.e. Action Design Research and explains why it is suitable for their research. The paper also identifies what are the main factors that should be taken into account in evaluation of the environmental and socioeconomic sustainability impact of ICTs technologies in a city. In addition, it suggests the enabler factors and domains where ICT technologies should be implemented. To structure these domains and categorise services grounded theory principles have been used. The authors advocate that this research will help in the identification of stakeholders that will and should contribute to the content design of the smart city maturity model.
HIGHLIGHTS:	The paper highlights that: 1) their grounded theory principles reflect well the main concepts founded in the literature review and in the smart cities initiatives that are been implemented around the world; 2) they proposed an innovative smart city strategy, which allows the involvement of city stakeholders in the content design of maturity model of smart cities.

TITLE:	**Technological Innovation and Complex Systems in Cities**
AUTHOR(S):	M. Dodgson, D. Gann
YEAR:	2011
VENUE:	Journal of Urban Technology
SUMMARY:	The paper explores how the emerging or “Innovations Technologies” (IvT) can be used to integrate the smart systems and improve the decisions and stimulate consensus. A brief case study where IBM’s smart city strategy based on instrumentation, interconnection and intelligence is present. The results show that the emerging technologies can be very useful into the development of integrated systems, contributing this way to effectively overcome the city challenges.
HIGHLIGHTS:	The paper highlights that: 1) simulation, modelling, visualization and virtual reality can help create city models, simulate the city decisions and build the necessary consensus for solving problems; 2) the massive sensing, data collection and modelling can help better understand how the city works, improve the citizen services and enhance environment; 3) these technologies could be explored to improve cities sustainability; 4) cities are digital labs with infinite varieties; there is a pressure in research to have more innovation in cities and it should go beyond ICT; 5) additional research is needed in innovative processes related with complex problems in cities.

TITLE:	**Technologies for reducing environmental load of next-generation smart cities**
AUTHOR(S):	T. Uzumaki
YEAR:	2014
VENUE:	Fujitsu Scientific and Technical Journal
SUMMARY:	The paper presents an energy harvesting technology based on machine-to-machine (M2M) communication, environmental management technologies and technologies for measuring the environment with the aim of reduce environmental impact of future smart cities.
HIGHLIGHTS:	The paper highlights that: 1) the technologies used in this work (M2M, environmental management technologies, and environmental measurement technologies) are the main drivers of innovation; 2) the deployment of a human intelligent society powered by ICT allows to create sustainable cities in terms of environmental protection and economic growth.

TITLE:	**The BRIC, instrument of urban intelligence for the Brussels-Capital Region**
AUTHOR(S):	M. Feuillien, M. Van Vooren
YEAR:	2014
VENUE:	2014 Euro Med Telco Conference (EMTC)

SUMMARY:	The paper addresses the strategy for the next five years of Brussels Informatics Centre (BRIC) to transform Brussels in a smart city. The fundamental principles of their strategy is to guarantee the durability, efficiency and innovation of the public administration services.
HIGHLIGHTS:	The paper highlights that: 1) the digital agenda of Brussels started 20 years ago with incentives to digital transition; 2) the challenges for the next five years are to give a better quality of life to its citizens, companies and organizations; 3) failing this purpose is not an option because this could compromise the future of the next generations.

TITLE:	The Business Models and Information Architectures of Smart Cities
AUTHOR(S):	G. Kuk, M. Janssen
YEAR:	2011
VENUE:	Journal of Urban Technology
SUMMARY:	This paper examines two case studies in the Netherlands. One case is focused on a business model through the use of ICT for improving existing services and bring a new one. The other case study is focused on the creation of an ICT infrastructure, which should serve as a platform to foster best business practices. They conclude that the first case is faster in accumulating business value, giving rise to new services more quickly, whereas the second is slower in bringing new services, is more resource-intensive, however, the services over time are improved and sustainable.
HIGHLIGHTS:	The paper highlights the following aspects: 1) governments adopt one strategy that goes beyond the innovation on front- and back-ends; 2) new business models and supporting information architectures need to be developed simultaneously with front- and back-ends innovations.

TITLE:	The business requirements and technical fabric for the Smart City
AUTHOR(S):	E. Smith, M. Ugolini, A. Neri
YEAR:	2014
VENUE:	2014 Euro Med Telco Conference (EMTC)
SUMMARY:	This paper gives an overview on how cities are developed and how a city is characterized. The focus is on what are the purposes of developing a smart city, its relation with business model and on its services, sensors and networks. The paper makes an evaluation of the smart city's enterprises and its evolution in the UK and Italy.
HIGHLIGHTS:	The paper highlights that: 1) the evolution of smart cities have been seen in the view of underlining technologies, market research and academic; 2) although technologies are crucial, will be the market that will determine how they should be deployed; 3) smart cities initiatives should be design with a long term view of returns and well integrated partnerships and the benefits to citizens should be measured.

TITLE:	The changing face of a city government: A case study of Philly311
AUTHOR(S):	T. Nam, T. Pardo
YEAR:	2014
VENUE:	Government Information Quarterly
SUMMARY:	This paper describes a smart city initiative, a non-emergency contact program – Philly31 – that is part of the City of Philadelphia strategy to become a smart city. The authors conducted interviews with responsible of the Philadelphia City government to know how the above-mentioned program contributes to a more efficient, effective, transparent, and collaborative city government.
HIGHLIGHTS:	The paper highlights that: 1) in order to become smarter the city, governments should use the concept of smart city in a strategic way, keep aware of the duality of introducing new technologies, mitigate possible inter-organizational tension and conflicts, involve more citizens in neighbourhood issues; 2) the public governance and its service delivery should be provided in a more efficient, effective, transparent, and collaborative way; 3) strategies for making cities smarter should be developed.

TITLE:	The city as living laboratory: A playground for the innovative development of smart city applications
AUTHOR(S):	C. Veeckman, S. van der Graaf
YEAR:	2014
VENUE:	2014 International Conference on Engineering, Technology and Innovation (ICE)
SUMMARY:	The paper makes an overview of four collaborative smart city initiatives in Europe in order to investigate how citizens could be involved in the process of open innovation. The paper presents an analytical framework on the innovation ecosystem and on the citizens' capacities to get involved in the public decision. The results showed that the process of designing public services could be done by both city and citizens, if the right tools are provided and aligned with the capacities of the citizens.
HIGHLIGHTS:	The paper highlights that: 1) the citizens with the right tools can have an active role in the evolution of their cities; 2) living labs are important as intermediary of open innovation ecosystems; 3) there will be no smart city without smart citizens.

TITLE:	The Future Internet
AUTHOR(S):	L. Srivastava, A. Vakali
YEAR:	2012
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	This paper proposes a novel framework based on narrative-aware method to design smart city systems. The framework takes into account an environment with Internet of Things installed and with a human storytelling network always on.
HIGHLIGHTS:	The paper highlights that: 1) the integration of sensors and social data could provide a more holistic view and context-aware information for residents, visitors and authorities; 2) the framework produces qualitative data based on sensors and human stories (e.g. social networks); 3) the narrative design offer by framework benefit all city actors in a broad range of services; 4) holistic view of the framework allows the development of smart cities with context-aware and user-centric services.

TITLE:	The Future Internet
AUTHOR(S):	H. Schaffers, N. Komminos, M. Pallot et al.
YEAR:	2011
VENUE:	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
SUMMARY:	This paper discusses the concept of smart cities under the perspective of open environments and user driver innovation. The smart city concept is explored as open environments with user-driven innovation processes where future Internet services could be tested and validated.
HIGHLIGHTS:	The paper highlights that: 1) the infrastructures for Internet services are key determinants of the welfare of cities; 2) the infrastructure for education and innovation, between businesses, governments, and citizens, fosters the innovation and quality of services; 2) the living labs are a powerful tools to view how user-driven open innovation ecosystems could be organized; 3) test beds, living labs facilities, user communities, technologies, know-how, data and innovation methods are common resource for research and innovation.

TITLE:	The real-time city? Big data and smart urbanism
AUTHOR(S):	GeoJournal
YEAR:	2013
VENUE:	R. Kitchin

SUMMARY:	This paper addresses the production of big data subject in smart cities. It gives some examples of cities that are being instrumented with ICTs equipment to produce big data. The authors advocate that this data could be used to make real-time analysis of city life in order to design new models of governance and more efficient, sustainable, competitive, productive, open and transparent cities.
HIGHLIGHTS:	The paper highlights that: 1) for citizens, big data could offer insights of city life, help in daily activities and in decision-making process; 2) for governments, big data offer a more efficient city management and regulation; 3) for corporations, big data offer business opportunities; 4) big data also raises several concerns, namely technocratic governance, corporatisation, system vulnerabilities and ethical issues.

TITLE:	**The role of small cell technology in future Smart City applications**
AUTHOR(S):	A. Cimmino, T. Pecorella, R. Fantacci et al.
YEAR:	2014
VENUE:	Transactions on Emerging Telecommunications Technologies
SUMMARY:	This paper is focused on communications aspects of smart cities. In particular, it addresses the latest developments in the 4G mobile technologies. The authors propose a network architectures for smart cities based on small cells.
HIGHLIGHTS:	The paper highlights that: 1) the technology challenges for future smart city are the machine-to-machine communications, security, spectrum utilisation and the potential bottleneck of small cells in the backhauling; 2) the urban areas are a perfect place to start with a new approach in the design of ICT infrastructures and services; 3) with specific regulations it is possible to build a new generation of smart city platforms; 4) the cloud infrastructure needs to be improved to deal with the future Internet composed by people, content and things; 4) the role of small cells to provide more broadband to cities and at same time can reduce the environmental impact; 5) the next LTE-A standard should include the small cells concept; 6) the integration of the different types of communication (M2M and P2M) represent a big challenge that should be addressed in the future 4G standards.

TITLE:	**The Triple-Helix Model of Smart Cities: A Neo-Evolutionary Perspective**
AUTHOR(S):	L. Leydesdorff, M. Deakin
YEAR:	2011
VENUE:	Journal of Urban Technology
SUMMARY:	The work shows how the triple-helix model could be used to support the evolution of cities in innovation process. It discusses that cities could be organized in three important dimensions: the intellectual capital of universities, the wealth creation of industries, and the democratic local government of a city.
HIGHLIGHTS:	The paper highlights that: 1) the intellectual capital of universities, the wealth creation of industries, and the democratic local government of a city, are dynamics spaces of ubiquitous ICTs where the knowledge is the key for innovations and therefore for the creation of smart cities.

TITLE:	**Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the "Historic Urban Landscape" Approach**
AUTHOR(S):	L. Girard
YEAR:	2013
VENUE:	Sustainability

SUMMARY:	This paper addresses the smart and sustainable development of port cities. The authors proposed the adoption of the Historic Urban Lanscape (HUL) approach to make the transition towards a smart city model that takes into the account the local characteristics and resources and not only the ICT.
HIGHLIGHTS:	The paper highlights that: 1) port cities are rich in potential opportunities, present an increasing potential growth and their landscape should be considered for smart development; 2) the present integrated smart development model contributes to have a more ecological resilience urban areas; 3) the conservation of urban cultural heritage contributes to stimulate the cultural identity and the sense of place; 4) creativity, resilience and sustainability are the main principles of the HUL approach; 5) HUL could be an very useful tool to implement smart sustainable development of port cities; 6) an assessment of the best practices for smart cities implementations is fundamental to learn with the past lessons before the implementation of the smart city project.

TITLE:	Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco
AUTHOR(S):	J. Lee, M. Hancock, M. Hu
YEAR:	2013
VENUE:	Technological Forecasting and Social Change
SUMMARY:	This paper proposes a conceptual framework for smart city. The authors used this framework to analyse two leading cases in US (San Francisco city) and Asia (Seoul Metropolitan city). The empirical results showed that an effective and sustainable city is the result of the dynamism of the public and private sectors where the coordination of their activities and resources is made through an open and innovative platform.
HIGHLIGHTS:	The paper highlights that: 1) eight stylized facts for building an effective smart city were identified; 2) the study confirms that the open data allows increase the development of new apps, but rises security concerns; 2) there should be a balance between diverse service exploitation and intensive service exploitation; 3) service exploitation typically needs many public funds, however it stimulates innovation in products and services; 4) market-oriented partnerships provide a more sustainable development of cities. 5) the top-down approach for implementing smart cities and a good publicity can help the adoption of smart city plan at an early stage; 6) the bottom-up approach has an opposite result, but the citizens became more engaged with smart city project; 7) citizen incentives to green initiatives help its adoption; 8) a centralized governance and a comprehensive strategy allow a more effective coordination and control of smart city project; 9) managers and policy makers should consider that each city has its own organizational culture, therefore the adoption of smart city services could have different rhythms.

TITLE:	Towards the development of quality of life indicators in the 'digital' city
AUTHOR(S):	M. Craglia, L. Leontidou, G. Nuvolati et al.
YEAR:	2004
VENUE:	Environment and Planning B: Planning and Design
SUMMARY:	This paper makes a literature overview on quality of life indicators in digital cities. The authors argue that new dimensions have to be added to build appropriate indicators for cities qualified as digital cities. The aim of this work is to discuss how to define such suitable indicators, their development requisites, and suggest some possible avenues to deal with these challenges.
HIGHLIGHTS:	The paper highlights that: 1) some key theoretical and methodological subjects involved in the definition of quality of life indicators were identified; 2) the proposed methodology to construct the indicators provides a good reference point for policy makers that want to improve the quality of life in the cities; 3) we are far away of having consensual definitions of indicators of quality of life or a common methodology to apply them in order to have a fair comparison among cities.

TITLE:	Unpacking a smart city model: The hegemony of ecological and information paradigms in urban space
AUTHOR(S):	Marciano, Claudio
YEAR:	2013
VENUE:	International Journal of Interdisciplinary Environmental Studies

SUMMARY:	This paper addresses the role of the information as a way to connect and to create collective intelligence to solve city problems. The authors advocate that an information infrastructure linked with citizens' human capital is capable to change the power between social systems. However, this means that is necessary to deploy a platform able to link citizen, firms and public organizations around a common database to share opinions and information.
HIGHLIGHTS:	The paper highlights that: 1) social sciences define the smart city concept based on ICT innovation, human capital and environmental sustainability; 2) the focus of the paper is on the role of information and on environmental sustainability; 3) after being analysed the theories in terms of information and ecology for smart cities, the authors lauched two basic functions - reduce the complexity and increase the social interdependence; 4) a basic notion of smart city project is to create a platform that manages the communication flows of all city systems.

TITLE:	Using standards to enable the transformation to smarter cities
AUTHOR(S):	J. Hogan, J. Meegan, R. Parmar et al.
YEAR:	2011
VENUE:	IBM Journal of Research and Development
SUMMARY:	This paper provides an overview of the current deployment of key standards for smart city systems and shows how these standards are important, even critical, to the creation of city systems.
HIGHLIGHTS:	The paper highlights that: 1) a set of standards must be interconnected to enable smart city operationally and policy maker achieve their goals; 2) new standards must be created and some of the existing standards must mature; 3) a clear motivation for standard-makers its required; 4) several changes in standards are related with integration issues and historically the standards were made separately; 5) governmental policies are the primary driving force for this change in standards; 6) new standards for inter-work between cities are required; 7) the IT industry assumes also an important role in the adoption of standards to enforce the smart city view in a reality.

TITLE:	Will the real smart city please stand up?
AUTHOR(S):	R. Hollands
YEAR:	2008
VENUE:	City
SUMMARY:	The paper criticises the way the label Smart City is used. The authors defend that we cannot label a city as smart just because it has a sophisticated information technology infrastructure or makes a self-promotional website.
HIGHLIGHTS:	The paper highlights that: 1) to what extend the term smart city could be seen as a high-tech entrepreneurial city and introduces to debate of smart cities the social justice element as a way to promote more progressive, intelligent and inclusive cities.

B. Policy Literature Review

B.1. Reviewed Policy Papers

TITLE:	Global Governance and Global Rules for Development in the Post-2015 Era
AUTHOR(S):	DESA – UN
YEAR:	2014
VENUE:	www.un.org/en/development/desa/policy/
SUMMARY:	This document identifies approaches in order to development strategies and objectives for the post 2015 era for the Member States of United Nations.
HIGHLIGHTS:	The document highlights that: 1) a global intergovernmental cooperation partnership is crucial for Member States' development; 2) the intergovernmental cooperation is also needed for global policy decisions, rules and norms, in particular for multinational institutions; 3) it is necessary to strength global governance and global rules to manage with the increasing interdependence among countries and to reduce inequalities; 4) the existing global partnerships are not truly comprehensive; 5) the reforms of global governance and global rules should follow five principles - Common but differentiated responsibilities and respective capacities, Subsidiarity, Inclusiveness, transparency, accountability, Coherence and Responsible sovereignty; 6) The probability of failing will remain high if global challenges continue to be approached from the narrow national perspective.

TITLE:	ANRE ' s Initiatives for Establishing Smart Communities Definition of Smart Communities
AUTHOR(S):	Division, Policy Planning, Energy Conservation and Renewable Energy Department- Japan
YEAR:	2014
VENUE:	www.meti.go.jp
SUMMARY:	This document was produced by the ANRE(Agency for Natural Resources and Energy) Japanese agency and presents the policy actions for establishing smart communities.
HIGHLIGHTS:	Some of the most important policy actions in Japan: 1) Ohira Village: an organization is deploying a smart community project in which it uses plants as core facilities and supplies electricity and heat to other entities located in an industrial complex. It plans to supply power to the areas surrounding the Ohira Village Office in case of an emergency. 2) Miyako City: a project for renewable energy produced by biomass power plants using rich forest resources in the region, and by mega solar power plants which are scheduled to be introduced in the region.

TITLE:	Smart cities ISO's challenge
AUTHOR(S):	ISO Focus+
YEAR:	2013
VENUE:	The Magazine of the International Organization for Standardization – Volume 4, nº1, January 2013
SUMMARY:	This special edition on smart cities addresses the main challenges of cities today and how ISO standards provide a support to improve city living.
HIGHLIGHTS:	This edition highlights that: 1) International standards aid to develop smart cities more energy efficient, safety, sustainable and more reliable and effective transports while in simultaneous they can reduce pollution and wastes; 2) it is necessary to anticipate and assess smart city project sustainability (ISO 37120); 3) A priority should be to build a common language for all stakeholders (ISO 37101).

TITLE:	EU-China Smart and Green City Cooperation " Comparative Study of Smart Cities in Europe and China
AUTHOR(S):	Ministry of Industry and Information Technology (MIIT) DG CNECT , EU Commission with China Academy of Telecommunications Research (CATR)
YEAR:	2014
VENUE:	White Paper – www.euchina-ict.eu
SUMMARY:	This report shows the findings of a study of 15 Chinese and 15 European pilot smart cities, explores the smart city trends and developments in China and Europe. An assessment framework has been used to collect the information of smart city pilots. This assessment framework developed to make the comparative study could be used also as an internal tool for cities assessing their smart city status. EU-China smart city initiatives: EU-China Urbanisation Partnership and the EU-China Mayors Forum, EU-China Environmental Governance Programme, EU-China Sustainable Urbanisation Park, URBACHINA and EC-Link. In China, the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC), MOHURD and other departments have introduced the relevant regulations to standardize smart city development, such as, 12th Five-year Plan for the Development of Information Security Industry, 12th Five-year Plan for the Development of Internet of Things and 12th Five-year Plan for the Development of E-commerce. NDRC and MIIT, together with the Ministry of Science and Technology, the Ministry of Public Security, the Ministry of Finance, the Ministry of Land and Resources, MOHURD and the Ministry of Transport, are studying to draft Guiding Opinions on Promoting the Healthy Development of Smart Cities (hereinafter referred to as "Opinions"), which is to be submitted to the State Council for promulgation. The Opinions will clearly propose the ideas, principles, main objectives and development priorities for smart city development in China in order to unify thinking, build consensus and gather forces to strengthen guidance for smart city development practice throughout China.

TITLE:	Compendium of innovative e-government practices volume III
AUTHOR(S):	United Nations. Dept. of Economic and Social Affairs.
YEAR:	2010
VENUE:	Journal Economic & Social Affairs
SUMMARY:	This document explores how e-government applications can help to reduce the implementation costs of new systems. The compendium makes a compilation of e-government case studies. The 110 use cases are organized by regions: Africa, Asia and Pacific, Europe, North America, Latin America and Caribbean, Arab countries and they present 500 innovative practices over 100 countries.
HIGHLIGHTS:	The compendium highlights the following innovative practices: 1) citizens service delivery, e-participation, information access, e-health, information sharing/access, crisis management, e-accounting, e-commerce, e-customs, e-petitioning, e-voting, e-education, e-justice, e-procurement, e-taxation, e-inclusion, e-environment, gender equality, government portal, sustainable development, open government data.

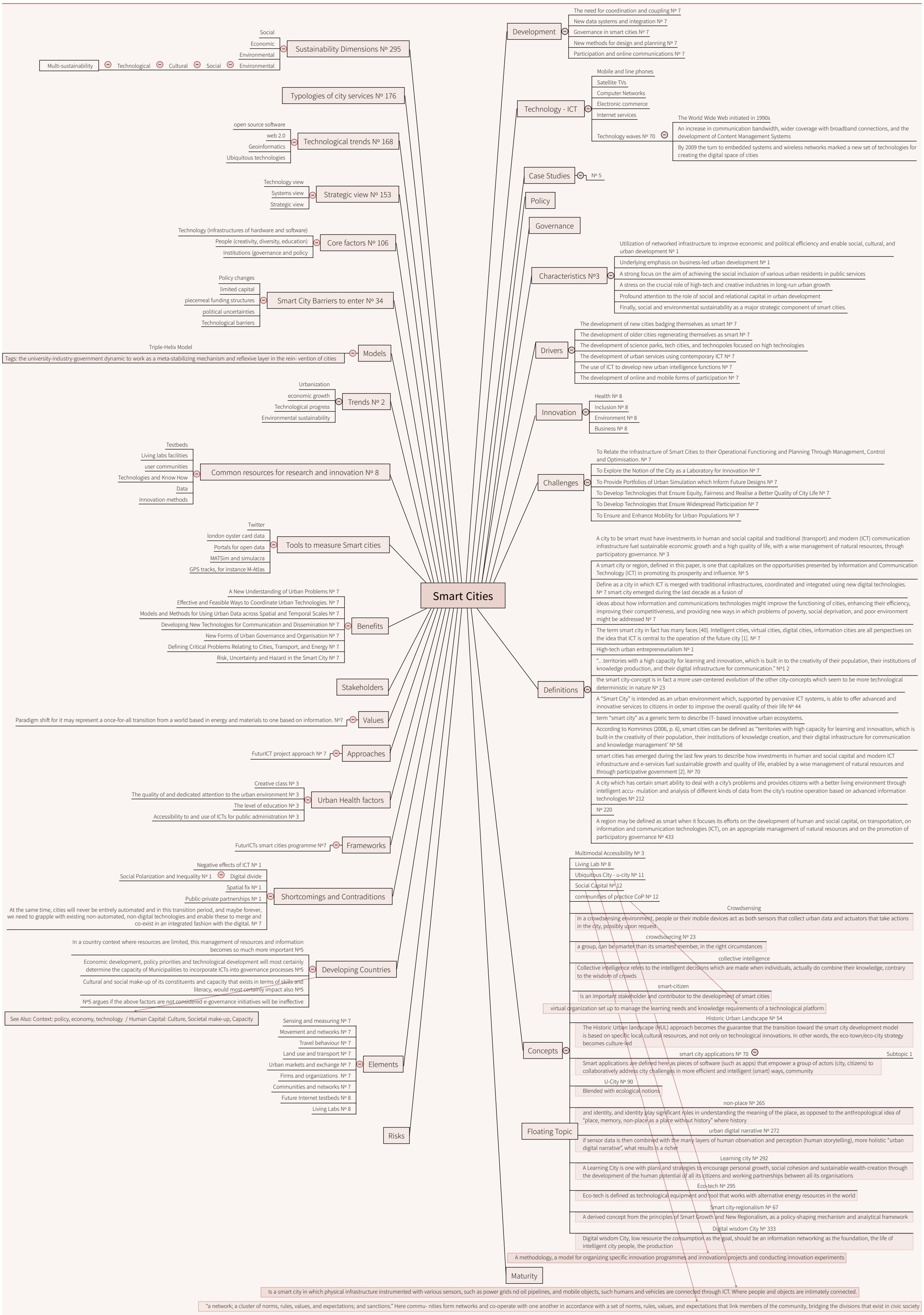
TITLE:	Mapping Smart Cities in the EU

AUTHOR(S):	Manville, Catriona Cochrane, Gavin Cave, Jonathan Millard, Jeremy Pederson, Jimmy Kevin Thaarup, Rasmus Kåre Liebe, Andrea Wissner, Matthias Massink, Roel Kotterink, Bas
YEAR:	2014
VENUE:	Report - www.europarl.europa.eu
SUMMARY:	This report provides an overview on smart cities in the European Union (EU) and makes an analysis of the Europe 2020 smart city initiatives.
HIGHLIGHTS:	The report highlights that: 1) Most Smart City initiatives are still in the early phases of development, but the larger cities tend to be the most mature (with at least one fully launched or implemented initiative); 2) The most common of the six characteristics defined in Chapter 2 are those associated with pan-European public goods problems – Smart Environment and Smart Mobility, present in 33% and 21% of initiatives respectively. Each of the other four characteristics (governance, economy, people and living) is addressed in approximately 10% of the Smart Cities, reflecting specific local strengths or weaknesses; 3) Some characteristics are likely to be found in combination with others, such as Smart People and Smart Living. 4) The objectives of the Smart City initiatives are generally aligned with those of city innovation and development strategies and the overarching Europe 2020 targets. 5) The characteristics of Smart City initiatives also reflect the actual situation of the city or country. 6) The match among different objective levels (Europe 2020, Smart City strategies and specific Smart City initiatives) is only approximate, indicating that Europe 2020 serves to stimulate and harmonize local action, but that other factors give each Smart City a unique flavor. 7) Most initiatives aim to contribute towards smart, sustainable and inclusive growth. Environmental issues and green solutions appear to be the principal concern; nearly 50% of sampled initiatives address environmental problems through improved energy efficiency in buildings or smarter city transportation options; 8) Smart City initiatives can be considered a useful vehicle for cities to achieve their Europe 2020 targets; 9) many Smart City initiatives, especially those that span multiple countries, are funded by the EU; 10) All the initiatives involved some degree of participation by government, private sector entities and civil society, but their roles and influence differed. 11) The objectives of the Smart City initiatives are generally aligned with those of the city innovation and development strategies, as well as with the overarching Europe 2020 targets. 12) Public authorities at all levels should consider ways to use demand-side measures to stimulate demand for city-based 'smart solutions'; 13) Designers of Smart City strategies and initiatives should ensure that they are based on explicit, specific, measurable, achievable, realistic, and time-dependent (SMART) objectives, clearly aligned to city development and innovation plans and (as need dictates) to Europe 2020 targets; 14) Eight generic smart city solutions that contribute to Europe 2020 target: Smart cycling plans, Integrated multi- modal transport, Smart Traffic flow system, Smart building technology and management, Smart City lighting, Smart open services platforms, Single access points for government services, Local integrated sustainability initiatives.

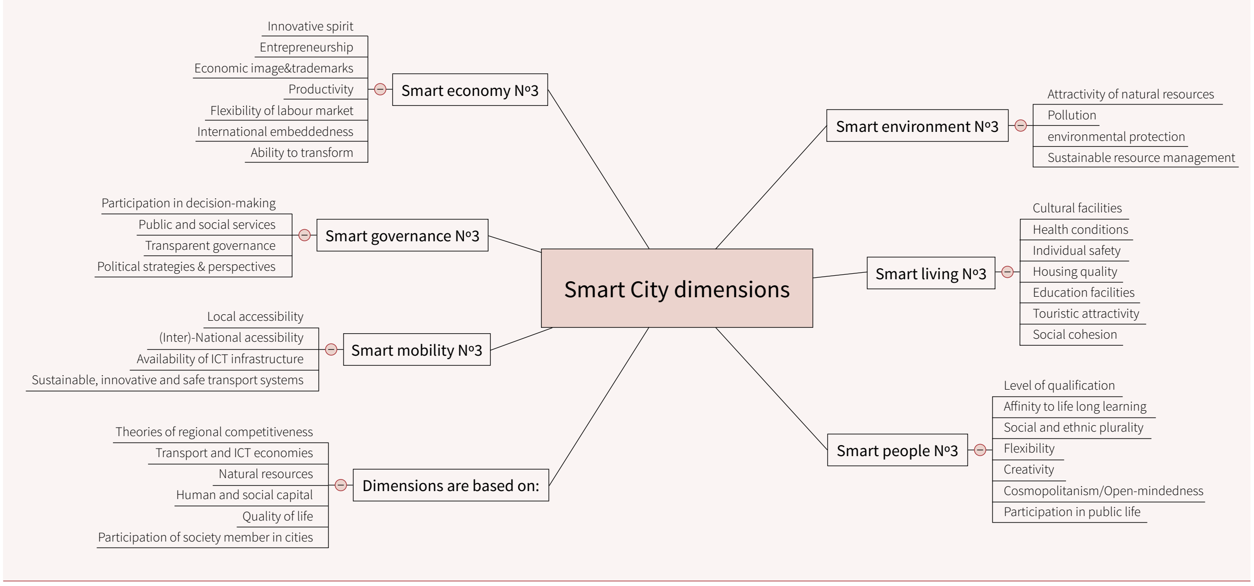
TITLE:	Smart Cities as Sustainable Innovation Actors - Insights from and for Portugal
AUTHOR(S):	Away, Take
YEAR:	2014
VENUE:	www.casi2020.eu
SUMMARY:	This paper shows how a firm, Living PlanIT, which sells smart city solutions, explores and exploits the innovation aspects of a city. The authors advocate that the interaction of different places and knowledge-based cities can allow the development of technology resources, search, experimentation, market information and have societal legitimation.
HIGHLIGHTS:	The paper highlights that: 1) different knowledge of cities and geographies are important for firms like Living PlanIT to develop a smart city solution; 2) the link between knowledge city assets and its functions is important and deserves more research attention; 3) firms like PlanIT could play an important role in the linkage of territories; 4) knowledge rich cities have higher diversity levels and are more innovative, and therefore offer more sustainable smart city projects; 5) cities branding have more facilities in legitimize the introduction of new technologies, influence decision makers and obtain resources.

B.2. Conceptual Maps

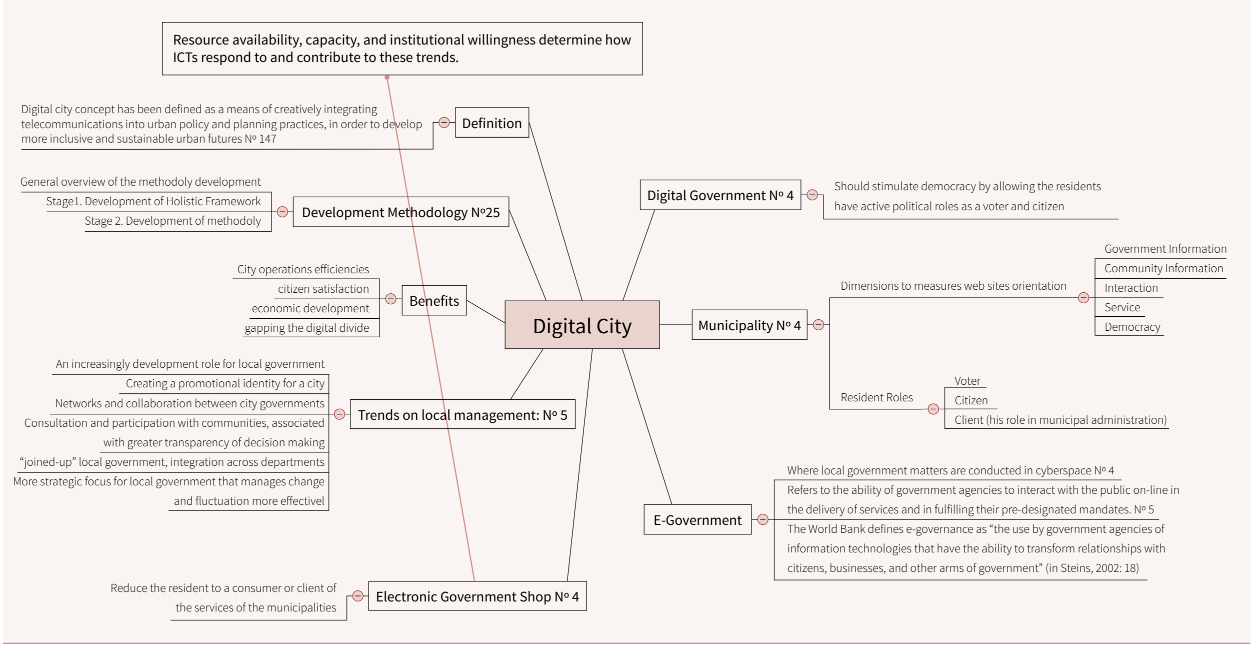
B.2.1. Smart City Map



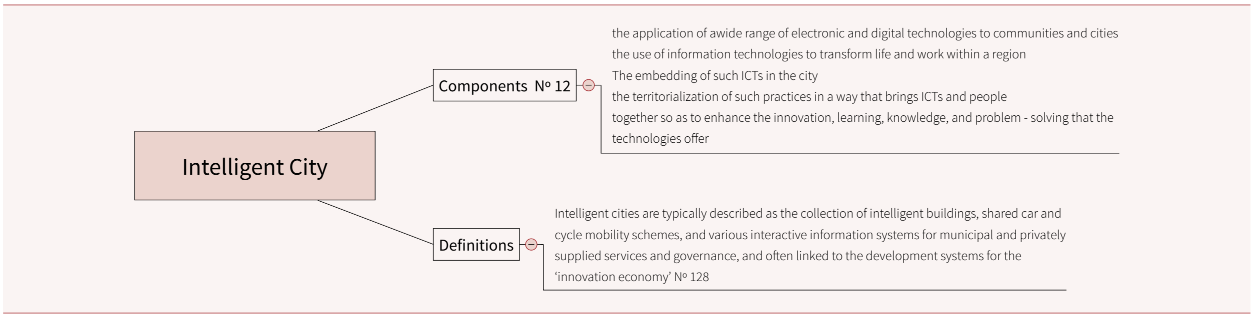
B.2.2. Smart City Dimensions



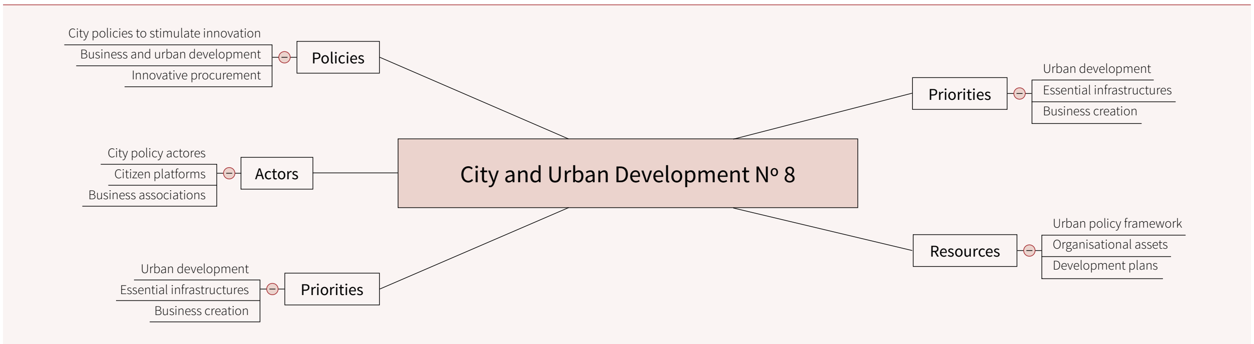
B.2.3. Digital City Map



B.2.4. Intelligent City Map



B.2.5. Urban Development Map



C. Case Study Development

C.1. Smart City Initiatives

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
1	Aarhus	Denmark	Smart Aarhus is a new mindset developed in order to create sustainable urban innovation and growth. Smart Aarhus wants to be an internationally leading, Scandinavian model for urban development based on partnerships.	http://www.smartaarhus.eu/
2	Abu Dhabi	United Arab Emirates	The project mission is to advance the clean energy industry in Abu Dhabi and around the world and to be a catalyst for the economic diversification of the Emirate.	http://www.masdar.ae/
3	Amsterdam	Holland	Amsterdam created a partnership between businesses, authorities, NGOs and citizens to develop the Amsterdam Smart City (ASC). ASC has several projects, which are organized in eight domains: smart mobility, smart living, smart society, smart areas, smart economy, Big and Open Data, Infrastructure, and Living Labs. The selected case study is the IJburg Living Lab.	http://amsterdamsmartcity.com/
4	Antwerp	Belgium	Blue Gate Antwerp is one of the most important economic projects in the region and will initially generate 1,500 to 2,000 jobs. While sustainability is the keyword in the Blue Gate Antwerp project, eco-effectiveness is the guiding principle. The principle entails closing cycles: no waste, and maximum reuse of water, materials and energy. New and innovative concepts in that field will provide a unique location for green companies.	http://www.bluegateantwerp.eu/en/partners (Manville et al. 2014)
5	Appolonia	Ghana	Appolonia - City of light is a plan to build a new urban area for housing, retail, logistics and manufacturing, within a plan framework designed to meet the specific needs of the local area.	http://www.appolonia.com.gh/about-us/city-of-light/

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
6	Arlington County	US	The e-Government Master Plan is a partnership with a venture capital firm to foster the creation of a vibrant ecosystem for national security technologies and ambitious redevelopment plan for Crystal City to house 26,000 new residents and attract 56,000 jobs in the kind of walkable, mixed-use neighborhoods.	http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/6/2014/01/DTS_EGovernmentMasterFullVersion.pdf
7	Atlanta	US	Atlanta is considered a reference hub for mobility innovations. The Metro Atlanta Chamber (MAC) Mobility Task Force was honored with a Smart City Initiative Award during the first-ever GSMA Mobile 360-North America Conference in Atlanta. GSMA is the organization that represents mobile operators worldwide.	http://www.metroatlantachamber.com/news/items/2014/10/06/gsma-honors-metro-atlanta-chamber-mobility-task-force-with-smart-city-initiative-award
8	Bangalore	India	Bangalore is developing in collaboration with CISCO a pilot project to provide smart parking, smart CCTV surveillance, smart street lighting, smart water management and community messaging.	http://gadgets.ndtv.com/internet/news/cisco-to-transform-bangalores-electronics-city-into-a-smart-city-551864; http://www.cisco.com/web/IN/about/files/cisco_smart_city.pdf; http://newsroom.cisco.com/press-release-content?type=webcontent&articleId=1492392; http://indiansmartcities.in/site/index.aspx
9	Barcelona	Spain	Barcelona is always very well placed in all smart city rankings. Currently, it has several innovative solutions for smart city services to manage city resources and improve citizens' quality of life. An interesting initiative is the sustainable Barcelona Map. Sustainable Barcelona Map is a virtual interactive map linked to the Open Green Map. It is also a social network for smartphones, which includes socio-environmental initiatives relevant to the city.	http://smartcity.bcn.cat/en
10	Beaufort	US	The Beaufort case study illustrates how the digital town hall can be used to embed place-based planning information and design codes into the town's e-governance structure.	(Walters 2011)
11	Belfast	Ireland	The city's vision is a city where ICTs and intelligence are used to create smart, sustainable cities with high quality levels for living and working.	https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study+-+Belfast+City+Council.pdf/02a5ef0a-b06a-4163-9271-91408eb94b7d
12	Berlin	Germany	In the European Green City Index, Berlin is number 1 in the buildings category and number 3 in the Water Management category. The capital is at the top of the Federal State Mobility Index when it comes to environmental protection and land use, and holds second place in the overall ranking. Some Berlin's smart initiatives include city open data and city electro-mobility.	http://www.berlin-partner.de/fileadmin/user_upload/01_chefredaktion/02_pdf/publikationen/Smart_City_A4-Folder_e_web.pdf

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
13	Bilbao	Spain	Strategic Plan for the Revitalization of Metropolitan Bilbao. The Strategic Plan envisions an “intelligent and integrated” urban growth where economic, social and environmental concerns must be carefully balanced.	http://www.bm30.es/homeage_uk.html (Manville et al. 2014)
14	Bletchley	UK	Bletchley was considered as the first intelligent city realized with the purpose of benefitting from knowledge and information flow in the context of spatial intelligence proximity (Komninos 2011). Therefore, it is an interesting case of an intelligent community that could facilitate and empower the smart city implementation process.	http://www.urenio.org/2015/01/22/smart-city-strategy-bletchley-park-uk/ (Komninos 2011)
15	Bogotá	Colombia	Bogotá has launched in the spring of 2011 a process to engage the population of the city to reinvent Itself for the digital age. As a result of this activity, the public developed and delivered to the mayoralty candidates five proposals, which they requested to be included in the new mayor’s agenda.	http://www.huffingtonpost.com/don-tapscott/the-heartbeat-of-bogota-e_b_1222247.html
16	Bornholm	Denmark	The smart city plan has four cornerstones: Sustainable Business, Good Life, Green Technology and Nature Destination.	http://brightgreenisland.com/
17	Brisbane	Australia	CitySmart is an agency to promote the sustainability of Brisbane city through innovative projects that help cut the city’s carbon footprint and also potentiate economic opportunities. Some project examples are a District Cooling System, Electric Vehicles charging stations, “EzyGreen” - for saving energy at home, and “Watt Savers” for small business.	http://www.citysmart.com.au/ (Odendaal 2003)
18	Brussels	Belgium	The smart city strategy tries to respond to challenging issues for the development of the region: a connected region, a sustainable region, an open region, and a safe Region.	http://bric.brussels/en/about-the-bric/smart-brussels-a-smart-city-strategy-for-the-brussels-capital-region
19	Buenos Aires	Argentina	Buenos Aires, through its participation in the Microsoft CityNext initiative, is developing innovative solutions, like city mobility and incidents registration, to modernize the city.	http://smartcitiescouncil.com/resources/buenos-aires-uses-it-solutions-and-programs-support-government-citizens-youth
20	Busan	Korea	To promote Busan City’s status in the international community, the city government developed a strategic plan to become a Ubiquitous-City (U-City).	http://english.busan.go.kr/SubPage.do?pageid=sub020504
21	Changsha	China	The “Digital Changsha” Smart City project’s paradigm is “the man living in balance with nature”. Therefore, pedestrian planning, cluster zoning and garden integration, all are part of the smart city vision.	http://en.changsha.gov.cn/news/Local/201404/t20140420_558626.html
22	Changwon	Korea	The Changwon city won the United Nations Award of the Best Neighborhood Project. It was the first citizen-led local government project in South Korea	http://unpan3.un.org/unpsa/Public_NominationProfilev2014.aspx?id=2351

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
23	Chicago	USA	Chicago has a civic organization called Smart Chicago devoted for improving citizens' lives in the city through technology.	http://www.smartchicagocollaborative.org/
24	Cologne	Germany	Main smart city sectors include: Energy, Transport and Mobility, and ICT. Cologne has many ongoing smart city projects such as, "Klima Strasse", Ship-to-Grid and Smart Metering.	http://www.smartcity-cologne.de (Manville et al. 2014)
25	Copenhagen	Denmark	The city goal is to promote sustainable development for the city. Some sustainable integrated solutions include: 1) transport and cycling, 2) clean harbor and 3) reduce wastes.	https://stateofgreen.com/en/profiles/city-of-copenhagen
26	Coventry	UK	Coventry becomes a Living Lab and a member of the European Network of Living Lab. The initiative contributed to identify Coventry as an active city in the Smart City domain.	http://citylabcoventry.org/home.asp?slevel=0z0&parent_id=1
27	Curitiba	Brazil	Curitiba designed a Master Plan for the growth of the city. The plan includes connective corridors, large parks, neighborhood parks and social spaces.	http://depts.washington.edu/open2100/Resources/1_OpenSpaceSystems/Open_Space_Systems/Curitiba%20Case%20Study.pdf
28	Cyberjaya	Malaysia	Malaysia is building a future intelligent city named Cyberjaya. The city dream encompasses constructing working and living spaces for ICT professionals and experts from all over the world.	(Yusof and van Loon 2012) http://www.rvo.nl/sites/default/files/Smart%20Cities%20Malaysia.pdf http://2050.nies.go.jp/report/file/lcs_asialocal/cyberjaya.pdf http://www.theantdaily.com/Main/Malaysia-s-first-intelligent-city-finally-taking-flight http://www.urenio.org/2015/02/09/smart-city-strategy-cyberjaya-malaysia/ http://www.mia.org.my/new/downloads/circularsandresources/budget/2012/b19.pdf
29	Dongtan	China	The eco-city of Dongtan is a planned city for the island of Chongming in Shanghai. It envisions a sustainable design and urban planning, including an entirely self-sufficient energy system.	http://www.dac.dk/en/dac-cities/sustainable-cities/all-cases/energy/dongtan-the-worlds-first-large-scale-eco-city/
30	Dubai	United Arab Emirates	Dubai Smart Government is a pioneering initiative in the region to provide government online services across the spectrum of corporate and community life in the Emirate.	http://www.dubai.ae/en/AboutDubaieGovernment/Pages/default.aspx
31	Dublin	Ireland	Digital Dublin is the city's Policy and Practice initiative that identifies, map, benchmark and set targets for the development of a Dublin that is innovative, and uses digital tools and solutions effectively, efficiently and assists to drive the economy of the city. The smart city plan is being created with the idea - "everywhere digitally connected and sustainable city, from home to workplace, from streetscape to public park and from healthcare to education"	http://digitaldublin.ie (Maccani, Donnellan, and Helfert 2014)and is focused on the development of a Smart City maturity model. This paper focuses on the research methodology that is being used for this study, i.e. Action Design Research (Sein et al. 2011

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
32	Durban	South Africa	Durban has a long-term smart city plan, called Imagine Durban. The plan pursues the following objectives: 1) creating a safe city; 2) promoting an accessible city; 3) creating a prosperous city where all enjoy sustainable livelihoods; 4) celebrating cultural diversity, arts and heritage; 5) ensuring a more environmentally sustainable city; and 6) fostering a caring and empowering city.	http://www.imaginedurban.org/Pages/Longtermplan.aspx (Odendaal 2003)
33	Edinburgh	Scotland	The City of Edinburgh Council's Customer Services Strategy fulfills the vision of smart cities. A number of projects are being conducted including the Smart Cities pilots to deliver customer services defined in the strategy and improve the council's services.	http://www.smartcities.info/edinburgh http://www.edinburgh.gov.uk
34	Eko Atlantic	Nigeria	Expects to be the new financial epicenter of west Africa by the year 2020. The vision aims to transform land lost to the sea into city land. The project has two major environmental goals, reversing coastal erosion and relieving some of the pressure on land in Lagos.	http://www.ekoatlantic.com/
35	Enschede	Netherlands	City of Enschede treats road users as VIPs. VIP means "Vehicle Inductive Profile". Every detected vehicle leaves a unique mass-induction profile, comparable to a DNA profile or fingerprint. The objective is to improve the mobility in the city.	http://imtech.com/EN/traffic-infra/Traffic-Infra-Newsroom/Divisie-Imtech-Traffic-Infra-Homepage-Newsroom-Highlights/City-of-Enschede-treats-road-users-as-VIPs.html
36	Florence	Italy	Florence won the title of 'Smart City' from the Milan-based Information and Communication Technology Fair, SMAU, for its work to increase the city's social infrastructure and make data and information more accessible to the public.	http://firenzesmartcity.org/; http://www.envirofi.eu/Portals/89/Docs/Project/Presentations/130306_Dublin/Vannuccini-Opendata_in_city_of_Florence.pdf
37	Gothenburg	Sweden	The CELSIUS project in the city of Gothenburg looks for creating an intelligent heating system covering all houses and buildings. The objective is to have resource efficient heat and cooling systems.	http://celsiuscity.eu/ (Manville et al. 2014)
38	Guadalajara	Mexico	The Ciudad Creativa Digital (CCD) project aims to create an environment capable of generating knowledge, enhancing quality of life, fostering talent and innovative ideas through the intensive use of new technologies, in the Guadalajara city.	http://ccdguadalajara.com/
39	Gujarat	India	Gujarat International Finance Tec-City (GIFT) intends to be major financial center of India by providing integrated townships, a special economic zone and an international airport.	http://giftgujarat.in/ http://www.ibtimes.co.uk/indias-first-smart-city-takes-shape-western-state-gujarat-1496654
40	Gwangju	Korea	Gwangiu implemented a smart power grid system.	(Heo et al. 2014)
41	Haluza	Israel	Haluza is the first smart city of Israel, the vision is to have a sustainable society at social and environmental levels powered by science and technology.	http://www.haluzasmartcity.org/smartcityen

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
42	Hamburg	Germany	Hamburg has a global reputation as a green city. A major initiative was to evolve its port, Germany's largest, into a "smart port" that uses a computerized traffic management system to reduce gridlock. Data about emissions would be collected and analyzed to assist with pollution control.	http://www.cisco.com/web/tomorrow-starts-here/cars/hamburg/index.html?CAMPAIGN=Internet+of+Everyt_8
43	Helsinki	Finland	The city is testing smart city services - Living Lab. The goal is to be a leading testing environment for smart city services.	http://www.forumvirium.fi/en/project-areas/smart-city;
44	Ho Chi Minh	Vietnam	In September of 2012, the Vietnam government launched the National Green Growth Strategy. The strategy aims to achieve a low carbon emissions and to enrich natural capital, these factors will be the drivers to have a sustainable economic development.	http://tuoitrenews.vn/business/26473/lotte-japanese-partners-to-develop-2bn-eco-smart-city-in-vietnam (Komninos, Pallot, and Schaffers 2012)
45	Hong Kong	China	WISE CITY initiative aims to retain people and their talent in the city by introducing innovative and creative technological solutions, as well as, to become a smart city with high level of quality of life. In addition, Hong Kong has the objective to become a model of smart city.	http://www.wisecity.hk/project
46	Honolulu	USA	The city of Honolulu and IBM are transforming how citizens interact with government. By providing transparent and secure access to city data.	http://www.governing.com/smarter/public-safety/Becoming-a-smarter-city-Six-public-safety-projects-that-deliver-quick-results.html?promo_code=Microsite%20Module
47	Hope	Ghana	Hope City is a new "technology" city to be built at Pram Pram outside Accra, in Ghana. The vision of Hope city is a city filled with people who are connected as a community of believers with the purpose of loving God, loving people, and changing the world.	http://yourhopecity.com/ (Watson 2013)
48	Hsinchu	Taiwan	The overall objective of the Hsinchu Smart City Construction vision will be achieved through the implementation of e-Government, technological communities, and digital living.	http://icity.hccg.gov.tw/ENGLISH/iframe_in_construction.htm
49	Jeju	Korea	The South Korean Government selected Jeju, in June 2009, as the Smart Grid Test-bed, and broke ground in August 2009. Test-bed is the proof of a smart grid for a low carbon and a green growth strategy.	http://www.nuritelecom.com/news/spotlight/jeju_smart_grid.html
50	Kalkara	Malta	The plan is to transform the Ricasoli industrial state into a high-tech center, making it one of the biggest economic concentrations in Malta.	http://www.malta-gozo-property.com/harlon/EN/content/641/Smart_City_Malta
51	Kazan	Russia	Kazan e-government program provides all necessary services including all that make easier citizens' access to the state services.	(Sánchez et al. 2013)
52	Keihanna	Japan	The city smart project goal is to develop an energy management system able to minimize carbon emissions	http://jscp.nepc.or.jp/en/keihanna/index.shtml

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
53	Kigali	Rwanda	The Kigali Conceptual Master Plan aims at replacing an existing city for one entirely new where Dubai and Singapore are the main sources of inspiration.	http://www.kigalicity.gov.rw/spip.php?article1179 (Watson 2013)
54	Kigamboni	Tanzania	Kigamboni City has a plan to build an eco-city that will relieve Dar Es Salaam of congestion and land shortages.	http://kigamboninewcity.com/master-plans (Watson 2013)
55	King City	Ghana	A plan to build a new urban area in King City to attract visitors to the offshore oil and gas exploration. The land will be used for residential, logistics, light industry and retail.	http://www.kingcity.com.gh
56	Kinshasa	Congo	Kinshasa has urban renewal projects that promise to bring "modernization" and make Kinshasa a "model for the rest of Africa".	(Watson 2013)
57	Kitakyushu	Japan	The Kitakyushu Smart Community Project seeks for creating appropriate infrastructures for low-carbon emissions by innovating lifestyles, business styles, and urban planning styles.	http://jscp.nepc.or.jp/en/kitakyushu/
58	Kochi	India	Smart City Kochi is one of the first two projects to construct a large network of knowledge-based industry townships across the world.	http://en.wikipedia.org/wiki/SmartCity,_Kochi
59	Konza	Kenya	The plan is to build a new city during the next 20 years. The city should be sustainable, green, a world-class technology hub and a major economic driver.	http://www.konzacity.go.ke/
60	London	UK	Smart London vision aims to arm the city with technology innovations making life, work and investments in London even better.	http://www.london.gov.uk/media/mayor-press-releases/2013/03/mayor-announces-smart-london-board-to-realise-london-s-ambition
61	Machakos	Kenya	The interesting aspect of this plan for a new city is that it is being promoted by the Government of Machakos County rather than by national government, reflecting a regional initiative under Kenya's new system of devolved government.	http://www.machakosgovernment.com/GovernmentPhotosMachakos.aspx?PhotoID=6 (Watson 2013)
62	Manchester	UK	Corridor Manchaster is a business site that aims to be the heart of Manchester's knowledge economy.	http://www.corridormanchester.com/our-vision
63	Mannheim	Germany	Mannheim connected every household in the city to a smart energy network.	http://www.dac.dk/en/dac-cities/sustainable-cities/all-cases/energy/mannheim-smart-city/
64	Maputo	Mozambique	The World Bank is trying to improve waste management with an initiative that uses crowdsourcing via mobile apps to gather input from citizens and waste collectors about the location of rubbish in the city.	http://www.scidev.net/global/cities/feature/developing-world-city-smart.html
65	Masdar	United Arab Emirates	Masdar Smart City Project is basically a showcase project in the energy sector. Masdar city intends to explore renewable energy and reduce the environmental impact.	http://www.masdar.ae

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
66	Medellin	Colombia	The large outdoor escalator built in Medellin connects the poor neighborhoods to the prosperous city's valley center. The system reduced the travel time from half an hour to just 6 minutes.	http://cityminded.org/2013-innovative-city-of-the-year-6358 http://www.negst.com.ng/documents/Governing_Smart_Cities/2-icegov2013_submission_80.pdf
67	Mexico	Mexico	The Digital Mexico promotes the use of ICT technologies as a tool for socio-economic development.	http://www.smartcbi.org/index.php/en/smart-talk/item/968-mexico/968-mexico; http://www.contraloria.df.gob.mx/index.php/innovacion-tecnologica/135-innovacion-tecnologica/1221-ciudad-de-mexico-capital-digital
68	Miskolc	Hungary	Miskolc implemented a geothermal heating system, reducing 40% gas emissions when compared with the previous gas heating system.	(Manville et al. 2014)
69	Montego Bay	Jamaica	Montego Bay will implement a pilot project to establish a Smart City Integrated Operating Control Centre (IOCC). IOCC consists into seven systems, including: 1) traffic signal control system, 2) route taxi and metro bus management system, 3) parking information system, 4) traveler information system, 5) automated traffic enforcement system, 6) crime prevention system and 7) disaster prevention system.	http://jamaica-gleaner.com/gleaner/20140201/western/western5.html
70	Montevideo	Uruguay	Montevideo is an example of Open Data Eco-System initiatives. The public data provided by Montevideo City enables the creation of several new open-data application initiatives. One of them was the GXBus initiative in 2013. The GXBus mobile application gives information to users about Montevideo public transports.	http://www.opendataresearch.org/sites/default/files/publications/Opening%20Montevideo-a%20case%20studyfinalII.pdf; http://www.cromo.com.uy/2012/06/gxbus-la-aplicacion-de-los-omnibus-montevideanos/
71	Montréal	Canada	The city created the Smart and Digital City office to become an internationally recognized city among smart cities. Its strategy is grounded in four axes: 1) collect, 2) communicate, 3) coordinate, and 4) collaborate.	http://ville.montreal.qc.ca/portal/page?_pageid=6037,129209634&_dad=portal&_schema=PORTAL
72	Munich	Germany	Munich Smart City Strategy aims to reduce carbon emissions, reduce consumption of energy, develop the economy and ensure a good quality of life. Munich is also known by its Smart Energy Grid System.	http://www.muenchen.de/rathaus/dms/Home/Stadtverwaltung/Referat-fuer-Arbeit-und-Wirtschaft/foerderung/pdf/IRBC-Benchmarking-2014-/WS-I-1-Lang.pdf
73	Nairobi	Kenya	In 2011 the IBM launched a white paper to turn Nairobi into a smart city. The white paper highlights transportation, energy and public safety as the three critical areas to address in line with the growth of Nairobi's more economically empowered and mobile younger generation.	http://www.nairobi.go.ke/ (Watson 2013)

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
74	Neopolis	Brazil	The Neopolis Project is about a world-class sustainable new city of eco-intelligence implementing the most innovative development strategy aiming at a green, smart, and intelligent community.	http://www.neapolis.com/smart-vision.php
75	New York	USA	New York City 311 is a centralized and all-purposed customer service center for New York's citizens, providing them access to non-emergency municipal services. The service is available 24 hours a day and seven days a week.	http://www.seattle.gov/light/conserve/resident/cv5_bs.htm
76	Nice	France	The Connected Boulevard initiative is a (pilot) experiment to study the benefits that can be delivered from Internet of Everything (IoE) applications in the city.	http://www.cisco.com/c/dam/en/us/solutions/collateral/industry-solutions/case-study-connected-blvd-ioe.pdf
77	Nizhniy Novgorod	Russia	Nizhniy is developing smart city initiatives, such as smart roads, crossroads, innovations in the public utilities, and use of energy-saving technologies.	(Sánchez et al. 2013)
78	Nusajaya	Malaysia	Nusajaya wants to be a world class benchmark in smart city design, implementation and operations.	http://www.nusajayacity.com/strategic/str.html
79	Oulu	Finland	The city of Oulu and the Oulu region with its developing infrastructure forms an excellent urban living lab. The City of Oulu has an internationally recognized tradition as an innovation center in several aspects of smart city development, such as technologies, business models and partnerships.	(Rantakokko 2012)
80	Paju	Korea	Paju decided to adopt U-City concept. The areas of smart services included in the concept are: Mobile, Transportation, Safety and Security, Environment, Healthcare, Water Management, Portal Integrated Operation Centre (IOC), and MPLS 10G Backbone Network Infrastructure.	http://www.gsma.com/connectedliving/wp-content/uploads/2012/05/6-Jin-Hyeok-Yang-Smart-Cities_KT_21JUN2012_Print.pdf
81	Paredes	Portugal	The future city will have a living laboratory for partners and companies, test bed for smart technologies, innovation center and an incubator for technology start-ups.	http://www.living-planit.com/design_wins.htm
82	Paris	France	Paris is known for its innovative Autolib' project, a project for a public transportation service with electric cars.	https://www.autolib.eu/en/our-commitment/urban-revolution/
83	Petronia	Ghana	A new urban area that aims at exploring oil, gas and mining industries.	http://petroniacity.com
84	Philadelphia	USA	An example of smart service, Philadelphia implemented the innovative 311 non-emergency contact program (Philly311).	(Nam and Pardo 2014)
85	Portland	USA	Portland has been regularly recognized as a relevant smart city, for instance, it has received the "Intelligent Transportation Systems America Smart City Award" as national leader in USA for the use of transportation technology.	https://www.portlandoregon.gov/ogr/article/479188

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
86	Porto Alegre	Brazil	The “Data Poa” Project aims to open the city data to programmers, companies and citizens for them to use it to create mobile applications and sites.	http://www.datapoa.com.br
87	Rey Abdullah	Saudi Arabia	The King Abdullah Economic City is an urban mega-project comprising a surface of 173km2.	http://www.structuralia.com/mx/unam/item/1001893-king-abdullah-economic-city-un-ambicioso-proyecto-urbano-en-arabia-saudita
88	Rotterdam	Netherlands	Rotterdam has a Climate Change Adaptation Strategy providing the most prominent examples of smart city services, including the construction of water squares and green roofs, as well as the heat transport network.	http://www.deltacities.com/newsletter/rotterdam-proclaimed-smart-city-2014?news_id=58
89	Samara	Russia	Samara authorities are efficiently employing resources of social networks to improve their image among the active net users, namely, the young ones.	(Sánchez et al. 2013)
90	San Francisco	USA	San Francisco has been honored as the Greenest City in the USA and Canada Green City Index and the Cleantech Capital of North America. It is considered a leader city on smart strategies for sustainability and innovation.	http://www.sfenvironment.org/news/update/designing-a-smarter-and-more-sustainable-san-francisco
91	Santa Clara	USA	Santa Clara opened a communications network to provide free public outdoor Wi-Fi access through the city.	http://smartcitiescouncil.com/resources/silicon-valley-powers-free-w-fi
92	Santander	Spain	The goal is to create a city-scale experimental facility with typical applications and services for smart cities.	http://www.smartsantander.eu/
93	Santiago	Chile	Santiago is the first smart city prototype of Chile. The prototype tries to accommodate all smart city dimensions.	http://www.smartcitysantiago.cl/reference-in-english
94	Seattle	USA	The Seattle Built Smart Program aims to guide the design and conception of green, healthy and comfortable buildings. The program also provides incentives for builders, developers and architects to construct energy efficient buildings.	http://www.seattle.gov/light/conserve/resident/cv5_bs.htm (Herrschel 2013)
95	Seoul	South Korea	The ITU-T Technology Watch Report has considered the Seoul’s implementation of its “Smart Seoul 2015” project the best-practice guide to the construction and operation of a smart city.	http://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000190001PDFE.pdf
96	Sidi Abdellah	Algeria	The Smart City Master Plan for Sido Adbellah New City aims at developing a new urban space specialized on science and technology.	http://www.gsma.com/connectedliving/wp-content/uploads/2012/05/Smart-Cities_25APR2012_final_Printed.pdf
97	Singapore	Singapore	Singapore Smart Nation Program seeks to build a smart city with high speed, pervasive, intelligent and secure ICT infrastructure, which supports all city systems in an integrated way.	http://www.ida.gov.sg/Infocomm-Landscape/Smart-Nation-Vision

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
98	Skolkovo	Russia	The aim of the Skolkovo project is to create a smart city to be an international innovation center.	http://sk.ru/city/ https://www.youtube.com/watch?v=J0oo2S-XRQ0 http://www.urenio.org/2015/03/05/smart-city-strategy-skolkovo-russia/ http://sk.ru/city/p/smart_city.aspx http://www.fastcoexist.com/1679376/the-skolkovo-project-can-russia-recreate-silicon-valley
99	Songdo	South Korea	Songdo Smart City Project was designed to convert Songdo into a global business hub, a green and sustainable city, a brand new city and a new aerotropolis. The Songdo U-City has also the world's largest integrated urban operation center, which includes traffic systems, disaster prevention and pollution control.	http://www.songdo.com http://www.koreatimes.co.kr/www/news/nation/2009/12/281_56996.html
100	Stellenbosch	South Africa	The Stellenbosch Innovation District, in collaboration with the local university, has built "smart shacks." The project is using alternative energy and mobile technology to address the needs of the people living in the shacks.	http://www.stellenbosch.gov.za/
101	Stockholm	Sweden	The Stockholm's key priorities in developing a sustainable smart city include the environment and ICT technologies. Stockholm has defined for its smart city plan green IT and e-services (public services) strategies.	http://international.stockholm.se/city-development/the-smart-city/
102	Surrey	Canada	Surrey created a Smart Surrey Strategy guide that explains and guides how technology and innovation can be used for decision-making processes like future plans, programs and infrastructures. It has four key areas of action: 1) social engagement and connectivity, 2) economic growth, 3) service delivery innovation and 4) smart city infrastructure.	http://www.surrey.ca/city-government/15430.aspx
103	Taichung	China	Taichung City is considered one of the most intelligent cities of China, based on the city extensive WiMAX wireless and fiber broadband coverage.	http://taiwantoday.tw/ct.asp?xItem=185705&ctNode=421 (Hsieh et al. 2014)
104	Tallinn	Estonia	Tallinn's is considered a city with smart businesses because it combines research and technology with the development and use of software. The philosophy is that a smart city must have smart people.	http://www.tallinn.ee/eng/uudised?id=26423; http://www.quora.com/Why-is-Tallinn-considered-a-smart-city
105	Tampere	Finland	The Smart City model of Tampere has three themes: 1) intelligent transport systems, 2) future housing and 3) resource-savvy networks. A strategic 10-year project ECO2 was started by the City of Tampere in 2010. In this project climate and energy objectives of Tampere are implemented, and mainly the city development practices are changed to support low-carbon economy.	http://www.investtampere.fi/how/innovation-programmes/innovative-cities-inka/inka-in-the-tampere-region/smart-city-tampere/

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
106	Tashu	China	An example of smart mobility, the TaShu System is a citywide public bicycle rental system managed using wireless network technologies.	(Heo et al. 2014)
107	Tatu	Kenya	The plan is to build a large scale urban area with residential housing, commerce, industry, tourism, social and recreation activities.	http://www.tatucity.com/
108	Tel Aviv	Israel	Tel Aviv received in 2014 the World Smart Cities Award at the Smart City Expo and World Congress in Barcelona. Israel's largest city was recognized for its initiatives in digitally connecting and engaging citizens with the municipality's activities.	http://www.tel-aviv.gov.il/eng/GlobalCity/Pages/SmartCity.aspx?tm=24&sm=73
109	Thessaloniki	Greece	The city is deploying broadband networks, smart urban spaces, web-based applications, and e-services pursuing the objectives of increasing competitiveness and promoting sustainable development.	(Komninos et al. 2012)
110	Tianjin	China	Tianjin Eco-city is a flagship project between Singapore and China to build a smart city with sustainable development. The vision is a city where people live in social, economic and environmental harmony.	(Fei 2012) https://globalsmartcity.wordpress.com/2012/06/20/china-tianjin-eco-city/; http://www.tianjinecocity.gov.sg/
111	Tilburg	Netherlands	The city of Tilburg has introduced smart interactive (LumiMotion range) streetlights by Philips. They provide light on demand, whenever an activity is registered on the road.	(Manville et al. 2014)
112	Toronto	Canada	Toronto is carrying out several smart initiatives such as, the new blue edge for waterfront revitalization and smart commute for mobility.	http://newblueedge.ca/nbe/portal; http://www.smartcommute.ca/toronto-central/
113	Toyota	Japan	The Toyota city low-carbon society verification project (Smart Melit) aims introducing renewable energy in houses to reduce carbon emissions.	http://jscp.nepc.or.jp/en/toyota/
114	Vancouver	Canada	Vancouver is implementing the Greenest City 2020 Action Plan with the objective of becoming the greenest city in the world.	http://vancouver.ca/green-vancouver/greenest-city-2020-action-plan.aspx; http://vancouver.ca/files/cov/Greenest-city-action-plan.pdf
115	Vienna	Austria	Smart City Vienna goal is to develop intelligent and innovative ICT solutions able to make sustainable use of resources.	https://smartcity.wien.gv.at/site/en/; https://smartcity.wien.gv.at/site/files/2014/10/140924_KF_SCW_gesamt_ENG.pdf
116	Vilnius	Lithuania	Vilnius City Mayor stated the goals in the area of smart cities including: 1) knowledge society development, 2) economic development, 3) innovation development and 4) city council effectiveness.	(Zavadskas, Kaklauskas, and Banaitis 2010)
117	Yokohama	Japan	The Yokohama Smart City Project goal is to transform the city infrastructures into a low-carbon production while maintaining the comfort of its residents.	http://jscp.nepc.or.jp/en/yokohama/

ID	CITY	COUNTRY	DESCRIPTION	REFERENCES
118	Yongin	Korea	Yongin designed and implemented a water quality assessment system for measuring the quality and flow of a river to predict water levels and detect water pollution.	(Heo et al. 2014)
119	Zaragoza	Spain	Zaragoza implemented its Bitcarrier Citysolver solution in order to have the city traffic information in real time, take decisions to manage traffic efficiently and provide citizens with such information so that they can make their own choices.	http://www.bitcarrier.com/zaragoza

C.2. Case Study Template

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	
INITIATIVE	
COUNTRY	

INTRODUCTION

This document is the result of a survey, which aims at identifying best practices in the areas related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development.

In order to obtain uniform descriptions of different programs, the survey relies on a conceptual framework for Smart Cities for Sustainable Development (SCV4SD) with five questions applied to each practice:

1. Who developed the practice? The question determines the institution developing the practice as well as its partners.
2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development.
3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt.
4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the social, economic or environment dimensions.
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, government initiatives, tools, governance mechanisms and others.

This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	
Case	

SURVEY			
Sources	No	Description	Reference
	1		
	2		
Highlights			
Comments			

SURVEYOR	
Who	
When	

WHO	STAKEHOLDERS			
	Partner	Name		
		Funder	☐ Yes ☐ No	
		Role		
	Type		☐	Government
			☐	Company
			☐	Non-Governmental Organization
	Partner	Name		
		Funder	☐ Yes ☐ No	
		Role		
	Type		☐	Government
			☐	Company
			☐	Non-Governmental Organization
	Partner	Name		
		Funder	☐ Yes ☐ No	
		Role		
	Type		☐	Government
			☐	Company
			☐	Non-Governmental Organization
	Partner	Name		
		Funder	☐ Yes ☐ No	
		Role		
			☐	Government
			☐	Company
			☐	Non-Governmental Organization

WHEN/WHERE	LOCATION AND TIME	
	Country	China
	State/Province	
	City	
	Region	
	Date	

WHAT	AIM		
	City Background		
	Concept	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☐ Smart City
		What is About Summary	
	Innovation(s)		
	Lessons Learnt		
	Comments		

WHY	RATIONALE		
	Drivers	☐ Economic Development	
		☐ Governance Development	
		☐ Mobility Development	
		☐ Environment Development	
		☐ Social Development	
		☐ Quality of Life	
	Benefits		
	Values		

HOW	IMPLEMENTATION	
	Approach	☐ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	
	Maturity	
	Challenges	
	Risks	
	Tools	
	Technologies	

C.3. Case Studies

C.3.1. Case Study 1 – Cisco Smart City in Bangalore, India

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID001
INITIATIVE	**Cisco Smart City in Bangalore**
COUNTRY	India

INTRODUCTION

This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development.

In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice:

1. Who developed the practice? The question determines the institution developing the practice as well as its partners.
2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development.
3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt.
4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others.

This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Cisco Smart City in Bangalore**
Case	ID001

SURVEY			
Sources	No	Description	URL
	1	India, in collaboration with CISCO under a Public-Private-Partnership (PPP), is creating a pilot smart city in Bangalore to serve as a blueprint for the 100 future smart cities planned to be built in the country.	http://www.cisco.com/web/IN/about/leadership/digital_india_partnerships.html http://www.cisco.com/web/IN/about/files/cisco_smart_city.pdf
Highlights	The Cisco Smart city model will be implemented and tested in Bangalore. The next phase of the project is the expansion of this model to other cities in India.		
Comments			

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	17 April 2015

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Indian Government (Karnataka)	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Cisco Systems	
		Funder	☐ Yes ☒ No	
		Role	Developer	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	India
	State/Province	Karnataka
	City	Bangalore
	Region	Southern Asia
	Date	2011

	AIM		
WHAT	City Background	Bangalore is the capital city of the South Indian state of Karnataka and has a population of about 8.42 million people. Known as the "Silicon Valley of India", Bangalore plays an important role in the export of information technologies (IT), while being the second-fastest growing major metropolis in India and home to many educational and research institutions. [Source: http://en.wikipedia.org/wiki/Bangalore]	
	Concept	Type	☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	Uses the Internet of Things (IoT) technology to connect education and healthcare systems, build smart buildings, and connect transports and smart parking to ensure economic, social and environmental sustainability.
	Innovation(s)	○ Network technologies for energy management, collaborative workspaces, indoor navigation and sign-based information.	
	Lessons Learnt		
	Comments		

	Drivers	☒ Economic Development	Outcome:	Develop the required environment for the creation of economic activities and employment opportunities.
		☒ Governance		Citizen-centric, efficient, accountable, and transparent.
		☒ Mobility		Cost-efficient and intelligent urban mobility system integrated through the use of technology.
		☒ Environment		Promote cycling, achieve 100% solid waste recycling, proper waste treatment, create an effective collection and disposal system, and reduce carbon emissions.
		☒ Social Development		Higher education in every neighborhood, e-Education and digital content. High quality healthcare facilities with the creation of an Electronic Health record for every resident and telemedicine in every neighborhood. Good entertainment facilities like theatres, concert calls, auditoriums, cultural centres, etc.
		☒ Quality of Life		affordable housing, cost efficient physical, social and institutional infrastructure, such as adequate and quality water supply, sanitation, 24 x 7 electric supply, clean air, quality education, cost efficient health care, dependable security, entertainment, sports, robust and high speed interconnectivity, fast & efficient urban mobility.
	Benefits	○ Smart parking system to help monitor the number of vehicles and indicate empty spaces; ○ Smart buildings that are operated and controlled with an intelligent system that reduces energy and water consumption; ○ Remote expert solution to offer remote local, regional and central public services to citizens; ○ Energy management system to control the energy consumption and manage the energy workflow; ○ Smart work spaces, which is a mobile and collaborative tool designed to enable employees to work together anywhere, anytime; ○ Connected learning is an interactive and collaborative e-Learning tool.		
WHY	Values	○ By estimative, smart buildings can reduce 40% of the energy consumed by normal buildings; ○ The energy management system is estimated to cut costs by 35%; ○ The remote expert solution allows the centralization of government resources and citizens do not need to travel long distances to have access to public services; ○ Connected learning provides remote education to students across the world and experts from all over the world can easily transfer their knowledge through this tool; ○ With the smart work spaces the employees can have more work flexibility and can work anywhere; ○ Improves the quality of life of citizens with the smart feature: smart parking, connected cafés, recreation and relaxation rooms, safety and security systems, a rooftop solar power system and indoor “neighborhoods” designed for employees to quickly meet; ○ The reduction of the carbon footprint and the energy costs provides a more sustainable city development.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The governance component of the Indian Smart City concept is citizen-centric, efficient, accountable, and transparent. It includes the participatory systems of governance, e-Governance, inclusive governance, the sense of safety and security, and the opportunities for creativity.
	Maturity	India has a Smart City reference framework with seven key principles: o Attract Young Wealth Creators and others; o Constant Physical Renewal; o Unique and Strong; o City Identity; o Connected to other Cities; o Inculcate innovative / out of the box thinking; o Investors; o Have Strong Political and Administrative Leaders.
	Challenges	Make cities more livable, resilient and able to respond to rapid changes. Financial and environmental sustainability.
	Risks	o The massive deployment of ICT could raise privacy and security concerns; o The social, ethical and legal impact of technologies; o Vision too centered in technologies.
	Tools	India Smart City reference framework, intelligent networks, Cisco Smart City, CiscoServiceGrid.
	Technologies	o Internet of Things; o Cloud computing; o Virtualization; o Collaboration tools; o Video; o Other evolving technologies.

C.3.2. Case Study 2 – Malaysia Multimedia Super Corridor, Malaysia

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID002
INITIATIVE	**Cyberjaya – Malaysian Multimedia Super Corridor Project**
COUNTRY	Malaysia

INTRODUCTION

This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development.

In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice:

1. Who developed the practice? The question determines the institution developing the practice as well as its partners.
2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development.
3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt.
4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life.
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others.

This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Cyberjaya – Malaysian Multimedia Super Corridor Project**
Case	ID002

SURVEY			
Sources	No	Description	Reference

	1	The Cyberjaya intelligent city is part of the Multimedia Super Corridor (MSC) Project, a technopole project launched by the Malaysian Government in 1996 with the goal of advancing the country's innovation and knowledge-based economy.	(Yusof and van Loon 2012) http://www.mia.org.my/new/downloads/circularsandresources/budget/2012/b19.pdf http://www.urenio.org/2015/02/09/smart-city-strategy-cyberjaya-malaysia/ http://www.theantdaily.com/Main/Malaysia-s-first-intelligent-city-finally-taking-flight Estevez, Elsa, Nuno Lopes, and Tomasz Janowski. 2015. *Smart Cities for Sustainable Development - Reconnaisance Study*. Yusof, N. and J. van Loon. 2012. "Engineering a Global City: The Case of Cyberjaya." *Space and Culture* 15(4):298–316. Retrieved February 9, 2015 (http://www.scopus.com/inward/record.url?eid=2-s2.0-84871821207&partnerID=tZOtx3y1).
Highlights	Cyberjaya is Malaysia's flagship cyber-city promoted in commercial leaflets as "one of the world's leading smart cities" and as a "test bed" for the integration of ICTs into everyday life.		
Comments			

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	17 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	Malaysian Government	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Setia Haruman Sdn. Bhd.	
		Funder	☒ Yes ☐ No	
		Role	As the master developer of Cyberjaya, it has the responsibility of developing the physical infrastructure of the city, as well as its facilities. Setia Haruman also has the responsibility of selling land to sub-developers and individual purchasers.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Malaysia
	State/Province	n/a
	City	Cyberjaya
	Region	South-Eastern Asia
	Date	1996

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Cyberjaya was created from scratch to be a smart city model for Malaysia. The project to build Cyberjaya (the Multimedia Super Corridor Project) was launched by the Malaysian Government in 1996. It was designed to have a residential capacity of 210.000 people but currently the number of residences is only 70.000. The intention is to accelerate Cyberjaya's development to reach 100.000 residents by 2016. The cumulative investment in infrastructures and buildings in Cyberjaya until the year 2014 was $4.7 (RM17) billions.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>The goal of Cyberjaya is to become a global technological hub by attracting world-class ICT companies, high-qualified professionals, and students.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovative aspect of the Cyberjaya smart city is the fact that it was designed for living and working purposes for employees in IT industries, an attempt to be a global technological hub. In a more global context the intention was to create a new Malaysian identity.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">Given the fact that Cyberjaya is growing at this very moment, this is the right time to invest in smart solutions in the region.</td></tr>
<tr><td>Comments</td><td colspan="2">The Malaysian government is proactive and is investing in smart initiatives to push forward the development of the country.</td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒
Economic Development</td><td rowspan="6">Outcome:</td><td>At local level, develop good economic and job opportunities in IT industry; at national level, transform Malaysia into a powerful global economy.</td></tr>
<tr><td>☒
Governance</td><td>Cyberjaya has an urban management system called “Cyberjaya City Command Centre” with the following applications (some of them still offer limited services): MyKad (high technology personal identification system), R&D cluster, e government, Technopreneur Development, e-Business, Telehealth and Smart School.</td></tr>
<tr><td>☐
Mobility</td><td></td></tr>
<tr><td>☒
Environment</td><td>Cyberjaya intends to reduce its CO2 emissions to 40% by the year 2020 compared with its 2005 levels.</td></tr>
<tr><td>☐
Social Development</td><td></td></tr>
<tr><td>☐
Quality of Life</td><td></td></tr>
<tr><td>Benefits</td><td colspan="3">○ Advanced technology infrastructure and facilities, including a Wi-Fi network that covers the entire city and a network backbone in optical fiber;
○ Digital personal identification;
○ R&D cluster;
○ e-Government;
○ Technopreneur development;
○ e-Business;
○ Telehealth and smart school;
○ Public safety and security;
○ Efficient waste management;
○ Energy savings in buildings.</td></tr>
<tr><td>Values</td><td colspan="3">○ Build a community in the city where most of its members adhere to and practice cultural values;
○ Reduce energy consumption and carbon emissions;
○ Build a social, livable and vibrant city;
○ Manage waste smartly (3R – Reduce, Reuse, Recycle).</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The smart city functions and operations are centralized into one unique system called the "Cyberjaya City Command Center". The intelligence and e-Governance of the city reside within this system.
	Maturity	The maturity of the Cyberjaya smart city model presents deficiencies in the following aspects: ○ Lack of one solution for urban mobility; ○ No relation between different city domains; ○ Absence of social and quality of life policies and practices; ○ Citizen engagement in city governance and communities is not visible.
	Challenges	○ There is also a lack of expertise / professionals to fulfill the potential of growth in the region. Nearly half of the population is not composed of qualified workers. The challenge is to attract qualified IT professionals and relevant IT players to the city; ○ Reinforcement of social and territorial cohesion; ○ Ensure equity and fairness among inhabitants; ○ Information networks with intelligent functions; ○ Improve competitiveness against international markets;
	Risks	○ The technology of the city is built on the principle of zoning and security, which leads to the sense of not belonging because the spaces are restricted to authorized people; ○ Social and ethical problems. The city has been criticized as "politically, ethnically and religiously determined" and for neglecting social life; ○ Tight surveillance causes negative experiences to city inhabitants and visitors. ○ Exclusive spaces could promote social exclusion; ○ As a place without history, memory and identity, most of the city inhabitants could live individually without embedding a community.
	Tools	○ Ubiquitous devices; ○ e-Government; ○ e-Business.
	Technologies	○ Information Technologies; ○ Multimedia Technologies; ○ Surveillance and Security Technologies; ○ Ubiquitous network; ○ Other evolving technologies.

C.3.3. Case Study 3 – Eko Atlantic Project, Nigeria

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID003
INITIATIVE	**Eko Atlantic Project**
COUNTRY	Nigeria

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Eko Atlantic Project**
Case	ID003

SURVEY			
Sources	No	Description	Reference
	1	The initial vision of the Eko Atlantic Project was to recover and transform the coastline of Lagos into a new city. To empower the project, Lagos state government set as a goal for the city to become the new epicenter of West Africa by the year 2020. The project has two major goals: economic development and reversing coastal erosion.	http://www.ekoatlantic.com/ http://en.wikipedia.org/wiki/Eko_Atlantic (Watson, 2013)
Highlights	Only private investors, national or international, invest in the project.		
Comments			

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	21 April 2015

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Lagos State Government	
		Funder	☒ Yes ☐ No	
		Role	Project manager	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	First Bank of Nigeria	
		Funder	☒ Yes ☐ No	
		Role	Funder	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Dar Al-Handasah	
		Funder	☐ Yes ☒ No	
		Role	Planning, design and implementation of the project.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Dredging International	
		Funder	☐ Yes ☒ No	
		Role	Dredging International role is to reclaim the land on which Eko Atlantic is being built.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	Nigeria
	State/Province	Lagos State
	City	Eko Atlantic City
	Region	Western Africa
	Date	2005

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Eko Atlantic is emerging from the sea as an artificial island with 10 km2, built with land reclaimed from the Atlantic Ocean due to sea erosion. The city is located in Bar Beach of Lagos state. Because it is a new city that is being built there, it has no previous history.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Digital City
☐ Intelligent City
☐ Knowledge City
☒ Eco City
☐ Ubiquitous City
☐ Smart City</td></tr>
<tr><td>What is About Summary</td><td>The main goal of this project is the economic development, however, the pretexts to build it are mostly related to environmental concerns.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">There is not any innovation in this project associated with the smart city concept. The innovative aspect of the project is the fact that the city is an artificial island made with sand reclaimed from the sea. The project also claims to be eco-friendly because its infrastructure provides the capacity to earn carbon credits.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The Eco City concept is being used to promote business- and economic-related goals.</td></tr>
<tr><td>Comments</td><td colspan="2">The Eko Atlantic project has a model that promotes private investment, however, the local citizens are completely set aside from it.</td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒ Economic Development</td><td rowspan="6">Outcome:</td><td>Attract international companies to the city in order to bring their skills to Lagos economic development.</td></tr>
<tr><td>☐ Governance</td><td></td></tr>
<tr><td>☐ Mobility</td><td></td></tr>
<tr><td>☒ Environment</td><td>Protect the coastline of Lagos; build eco-friendly energy infrastructures avoiding diesel dependency, trouble with waste and pollution in general.</td></tr>
<tr><td>☐ Social Development</td><td></td></tr>
<tr><td>☒ Quality of Life</td><td>Construct a ubiquitous communication network for businesses and people.</td></tr>
<tr><td>Benefits</td><td colspan="3">o An efficient energy system to provide uninterrupted power supply;
o A central water management system;
o Management of waste;
o Sewage treatment to keep the city healthy and safe;
o A state-of-the-art communication infrastructure;
o Environment protection;
o Promotion of technological and economic growth.</td></tr>
<tr><td>Values</td><td colspan="3">o Promotes the regeneration and sustainability of the region;
o Clean, healthy and safe city.</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	No information available.
	Maturity	The maturity of the Eko Atlantic Smart City model presents deficiencies in the following aspects: ○ Lack of one solution for urban mobility; ○ Only the economic and environmental domains of the smart city are addressed; ○ Absence of social and quality of life policies and practices; ○ Nigeria's citizens engagement in the project does not exist.
	Challenges	○ Frame the project within the Nigerian culture, society and characteristics; ○ Reinforcement of social and territorial cohesion; ○ Ensure equity and fairness among Lagos' citizens; ○ Plan the urban mobility; ○ Avoid the wild capitalism.
	Risks	○ The technology of the city is built upon the principle of zoning and security, which leads to the sense of not belonging because the spaces are restricted to authorized people; ○ Social and ethical problems. The city has been criticized as "politically, ethnically and religiously determined" and for neglecting the social life; ○ Tight surveillance causes negative experiences to city inhabitants and visitors; ○ Exclusive spaces could promote social exclusion; ○ As a place without history, memory and identity, most of the city inhabitants could live individually without embedding a community.
	Tools	○ Central Energy System; ○ Business and personal communication system; ○ Environment impact assessment.
	Technologies	○ Information Technologies; ○ Ubiquitous communication network; ○ Other evolving technologies.

C.3.4. Case Study 4 – Konza Technology City, Kenya

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID004
INITIATIVE	**Konza Technology City – Vision 2030 Project**
COUNTRY	Kenya

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Konza Technology City – Vision 2030 Project**
Case	ID004

SURVEY			
Sources	No	Description	Reference
	1	In 2009, the government of Kenya contracted the company International Finance Corporation to recommend and design the implementation of a global technology city able to foster the growth of outsourcing and IT industries in Kenya.	http://www.konzacity.go.ke/
Highlights	The city development will be made under a public private partnership in which the Kenyan government is responsible for developing the public infrastructures and regulations for the implementation of the city and its functions.		
Comments			

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	21 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	Kenyan Government	
		Funder	☒ Yes ☐ No	
		Role	Develops public infrastructures and regulations	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Tetra Tech, inc.	
		Funder	☐ Yes ☒ No	
		Role	Provides consulting services on economic development	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	OZ Architecture	
		Funder	☐ Yes ☒ No	
		Role	Plans and designs the city architecture	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Cisco System, Inc.	
		Funder	☐ Yes ☒ No	
		Role	Provides ICT solutions for city businesses and management	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Kenya
	State/Province	n/a
	City	Konza
	Region	Eastern Africa
	Date	2008

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">In 2008, the government of Kenya approved the creation of Konza City as the main Kenya Vision 2030 project. The Vision 2030 program aims to create a prosperous and competitive country with high quality of life by the year 2030.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>Konza intends to be the pinnacle of Kenya Vision 2030, a sustainable city with a world-class technology hub as a major economic driver.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">Konza is a well-planned open eco-system grounded in a smart ICT network, which integrates public and business services and citizen participation.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The creation of Konza City involves a wide consortium of entities, which are aligned by the smart city model as a means to reach a prosperous and sustainable city.</td></tr>
<tr><td>Comments</td><td colspan="2">The Konza project is trying to be developed following the best international practices on smart cities, however, it is unknown whether local characteristics are also being taken into account.</td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒
Economic Development</td><td rowspan="6">Outcome:</td><td>Create a sustainable, world-class technology hub and a major economic driver for Kenya.</td></tr>
<tr><td>☒
Governance</td><td>Citizen access to public services and participation.</td></tr>
<tr><td>☐
Mobility</td><td></td></tr>
<tr><td>☒
Environment</td><td>Achieve a sustainable environment.</td></tr>
<tr><td>☐
Social Development</td><td></td></tr>
<tr><td>☒
Quality of Life</td><td>Provide high quality of life.</td></tr>
<tr><td>Benefits</td><td colspan="3">o Public infrastructures for water, wastewater, solid waste, communications, power and transit operations;
o Infrastructure services for transportation, utilities, public safety and environment;
o Citizen access to public services;
o City services, such as city information, planning and development;
o Business services for local commerce.</td></tr>
<tr><td>Values</td><td colspan="3">o Give voice to the citizens;
o A city able to respond to the needs of its residents, workers and visitors;
o Enhance overall inclusiveness.</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The population of Konza will have direct access to the data collected from the city, which may include traffic maps, emergency warnings, and information describing energy and water consumption.
	Maturity	Konza has a smart city framework which integrates the city services, however, the maturity of its smart city model still presents deficiencies in the following aspects: ○ Lack of governance and service delivery models; ○ Absence of social policies and practices; ○ Lack of a self-assessment tool to assess the implementation of the smart city.
	Challenges	○ Define clear indicators for the quality of life; ○ Reinforce social and territorial cohesion; ○ Ensure equity and fairness among citizens; ○ Plan urban mobility; ○ Avoid wild capitalism.
	Risks	○ The project could have a negative impact on society; ○ Konza already has social polarization and gentrification problems, however, they can get worse; ○ Cost of the project; ○ Social exclusion of local residents.
	Tools	○ Smart city framework; ○ Smart communication system; ○ Sensor networks; ○ Data collection processes; ○ Software analysis and optimization; ○ Command & Control center.
	Technologies	○ Sensors; ○ ICT network; ○ Smart devices; ○ Data mining; ○ Cisco technologies; ○ Other evolving technologies.

C.3.5. Case Study 5 – Petronia City Project, Ghana

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID005
INITIATIVE	**Petronia City Project**
COUNTRY	Ghana

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Petronia City Project**
Case	ID005

SURVEY			
Sources	No	Description	Reference
	1	The strategy of the Ghanese government is to build a new city, which creates value and sustains the lifestyle of investors and companies working within Africa. The slogan is – “Work. Live. Learn. Play.”	http://petroniacity.com
Highlights	The city will be located in the Western Region, which is a region rich in natural resources and is seen as promising industrial hub for the exploration of large reserves of gold, bauxite, manganese, and oil.		
Comments	It seems that the city will be constructed only to support the investors, developers and mining companies, which want to explore the natural resources of the Western Region. The project is a paradox because it wants to promote mining and oil industries together with environmental sustainability.		

SURVEYOR				
Who	Nuno Vasco Lopes (researcher)			
	Mário Peixoto (editor)			
When	22 April 2015			

WHO	STAKEHOLDERS			
	Responsible Institution	Name	Petronia City Development Company Limited	
		Funder	☒ Yes ☐ No	
		Role	Development, planning, architecture, project management, construction and finance.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	AB & David – Lawyers for Business and Projects in Africa	
		Funder	☐ Yes ☒ No	
		Role	Advisor.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Adjaye Associates	
		Funder	☐ Yes ☒ No	
		Role	Advisor and architecture.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	AECOM	
		Funder	☐ Yes ☒ No	
		Role	Advisor and developer.	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Ghana
	State/Province	n/a
	City	Petronia
	Region	Western Africa
	Date	2013

WHAT	AIM		
	City Background	Petronia City is a 2000-acre master-planned city development project that aims to provide the first fully integrated business hub for West Africa's Oil, Gas and Mining industries. The proposed development is close to the Beahun and Yaabew communities in the Ahanta West District of the Western Region of Ghana. [Source: http://en.wikipedia.org/wiki/Petronia_City]	
	Concept	Type	☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	Petronia City intends to be an international industrial hub for investors and mining and energy companies.
	Innovation(s)	In terms of smart city concept there is no innovation, however, in terms of image and marketing, the city is published as an Energy City instead of a Smart City.	
	Lessons Learnt	The creation of Petronia City involves several private economic interests.	
	Comments	The project is being developed for a very specific target of communities, which are investors and entrepreneurs in the mining and energy industries.	

WHY	Drivers	☒ Economic Development	Outcome:	Position the city as an international platform for mining and energy industry.
		☒ Governance		
		☐ Mobility		Build a world-class hub to serve the daily commuters around the entire city. The hub will have between 8-12 helicopters.
		☒ Environment		Friendly and sustainable environment with zero carbon emissions.
		☐ Social Development		
		☒ Quality of Life		The infrastructures to build the commercial zones, residential, and recreational facilities will be world-class.
	Benefits	○ Electricity, water system, sewage treatment and storm water drainage; ○ Parking and Bus Terminal; ○ Master road network; ○ Data and Telecom networks; ○ Business services for local commerce; ○ Residential, hotel and commercial zone; ○ Free zone enclave; ○ Equestrian/Polo Grounds; ○ Petronia Motor Race Circuit.		
	Values	○ Increase shareholder value; ○ Create a room for developers and investors to see the value of investment in the natural resources of Africa; ○ Create a hub for major players in oil, gas, mining, finance, and for the Ghanese government to conduct businesses.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	During the development of the city, the governance and administration of the project will be taken care of by the Petronia City Development Company Co. Ltd.
	Maturity	The Petronia City project looks like it will have some maturity at transport, spatial planning, water management, sewerage, electricity and data, and telecom communications domains, although it seems completely flawed in what are the good practices of governance and citizen participation and engagement.
	Challenges	○ Involve the local citizens in the project; ○ Adapt the city to local characteristics and culture; ○ Ensure equity and fairness among local citizens and visitors; ○ Ensure environmental sustainability; ○ Avoid wild capitalism.
	Risks	○ Have a negative environmental impact; ○ Promote the social polarization and gentrification problems; ○ Non-attraction of investors; ○ Social exclusion of local residents; ○ To be exclusively a resource-based development.
	Tools	○ Oil & Gas University to knowledge transfer; ○ Equestrian/Polo Grounds for entertainment; ○ Petronia Motor Race Circuit for automobile industry.
	Technologies	○ State-of-the-art technologies to build the city infrastructures.

C.3.6. Case Study 6 – Smart Nation Program, Singapore

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance
CASE	ID006
INITIATIVE	**Singapore City – Smart Nation Program**
COUNTRY	Singapore

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Singapore City – Smart Nation Program**
Case	ID006

SURVEY			
Sources	No	Description	Reference
	1	The Singapore Smart Nation Program seeks to build a smart city with high speed, pervasive, intelligent and secure ICT infrastructures, which support all city systems in an integrated way. Powered by ICT technology, Singapore's strategy is to develop its economy and transform government and society through the innovative use of technologies.	http://www.ida.gov.sg/Tech-Scene-News/Smart-Nation-Vision http://epi.yale.edu/case-study/environmental-and-developmental-goals-coexist-singapore-rewriting-old-narratives http://www.mewr.gov.sg

Highlights	Program goals: ○ Be the number 1 of ICT industry in the global marketplace; ○ Increase two-fold the value of ICT industry; ○ Increase three-fold ICT exportations; ○ Create 80.000 new jobs; ○ 90% of the population with broadband access; ○ 100% of all school kids will have a computer at home.
Comments	The main focus of Singapore's Smart Nation Program is related to the development of its ICT industry as a means to achieve a more competitive and developed economy. One evidence of this strong focus on technology is the fact that the program will supported by the Infocomm Development Authority of Singapore (iDA).

SURVEYOR				
Who	Nuno Vasco Lopes (researcher)			
	Mário Peixoto (editor)			
When	23 April 2015			
WHO	STAKEHOLDERS			
	Responsible Institution	Name	Smart Nation Programme Office	
		Funder	☒ Yes ☐ No	
		Role	Coordination	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Infocomm Development Authority of Singapore (IDA)	
		Funder	☐ Yes ☒ No	
		Role	Management and implementation.	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Singapore
	State/Province	n/a
	City	Singapore
	Region	South-Eastern Asia
	Date	2014

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Singapore is a city-state island with no natural resources, with its economy mainly based on information technologies. Therefore, Singapore takes seriously the appointment of becoming a smart island. In 1981, the government set up the National Computer Board (NCB) with the mission of driving Singapore into the information age to enhance their economy and improve the quality of life. Since then, Singapore has been launching several programs to improve its rank within the information economy race. The last program, called the Smart Nation Program, tries to put in place the ICT infrastructures, policies, ecosystem, and capabilities to together support the creation of a Smart Nation.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>To spearhead the building of a Smart Nation, the Singapore government developed a 10-year master plan, iN2015, to speed up the growth of the ICT sector and its use to increase the economy competitiveness and improve the quality of life. The master plan aims to empower smart city functions with an ultra-high speed, pervasive, intelligent and reliable ICT infrastructure and to create intelligent and creative communities.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">Singapore is a country driven by technology innovations. The main difference from other smart cities is the fact of being a city-state, which means it is compact, efficient and fast in the implementation of new solutions, pilots and prototypes. During the last five years, Singapore e-Government has been ranked in first place in Waseda University “International e-Government Ranking”.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The smart Nation tries to build infrastructures and bring on board companies and talented people on IT from all over the world.</td></tr>
<tr><td>Comments</td><td colspan="2">Singapore believes that the smart nations program can successfully combine policy, resources, people and technology into a sustainable city/country development.</td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒ Economic Development</td><td rowspan="6">Outcome:</td><td>○ Be the number 1 of ICT industry in the global marketplace;
○ Increase two-fold the value of the ICT industry;
○ Increase three-fold the ICT exportations;
○ Create 80.000 new jobs.</td></tr>
<tr><td>☒ Governance</td><td>Release more data sets to the public to encourage the co-creation between government and citizens of smart city and improve e-participation in public affairs.</td></tr>
<tr><td>☒ Mobility</td><td>Enhanced Real-Time Bus information at your fingers. Achieve a cleaner and greener transport through the use of innovative green technologies (e.g. Green IT Initiative).</td></tr>
<tr><td>☒ Environment</td><td>The Sustainable Singapore Blueprint 2015 plans a more livable and sustainable Singapore through the following initiatives:
○ Eco-Smart Endearing Towns;
○ A Car-Lite Singapore;
○ Towards a Zero Waste Nation;
○ A Leading Green Economy;
○ An Active and Gracious Community.
The target areas are:
○ Green and Blue Spaces.
○ Mobility;
○ Resource Sustainability;
○ Air Quality;
○ Drainage;
○ Community Stewardship.</td></tr>
<tr><td>☐ Social Development</td><td>The ministry of Social and Family Development is responsible for the development of healthcare through smart policies, ICT infrastructures, programs and services. The ministry implemented the Social Development Network to promote marriages among single people. Women's legal rights are equal to men's legal rights.</td></tr>
<tr><td>☒ Quality of Life</td><td>The smart Nation is not confined only to economy growth. It is concerned with the improvement of quality of life for its citizens. The benefits generically involve savings related to time, effort and cost during daily life activities. For instance, paying bills, shopping, booking, reserves, libraries, browsing museums, etc., could be done efficiently through an ICT infrastructure.</td></tr>
<tr><td>Benefits</td><td colspan="3">○ Singapore's smart city implementation model includes a wide range of benefits, the most visible are:
○ Enhance the quality of life of its citizens;
○ Promote a sustainable economic and environmental growth;
○ Empower citizen talent;
○ Enhance city services;
○ Foster citizen participation in public decision-making process.</td></tr>
<tr><td>Values</td><td colspan="3">○ Cultivate social values, such as, citizen participation and sense of belonging;
○ Promote knowledge enrichment and transfer;
○ Promote collaboration for competences and skills development;
○ Foster a common collective goal in its society;
○ Involve citizens in neighborhoods activities;
○ Involve communities and stakeholders in the construction of new solutions.</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	e-Governance model
	Maturity	The maturity of Singapore towards a smart city is one of the highest, or even the highest, in the world. Singapore's smart city maturity is very advanced in all domains, such as mobility, governance, environment, social and living.
	Challenges	○ Maintain its competitiveness and economic growth; ○ Develop an e-Commerce hub; ○ Remain an international IT hub; ○ Avoid the technology polarization of citizens; ○ Reduce carbon emissions.
	Risks	○ Cyber-attacks; ○ Drastic changes in the IT international marketplace can deeply affect the economy; ○ Technology can divide the population; ○ Be exclusively an IT knowledge-based development.
	Tools	○ Smart Nation Platform; ○ Cloud; ○ Data Centre Park; ○ Data Market; ○ Heterogeneous Network (HetNet); ○ National Internet Measurement Infrastructure; ○ New ways of work; ○ Singapore Internet exchange; ○ Wired and wireless communications.
	Technologies	○ IPv6; ○ Geospatial; ○ Data&Analytics; ○ Green ICT; ○ Cyber security; ○ User interface; ○ Internet of Things; ○ Future Internet; ○ Big data; ○ Cloud computing.

C.3.7. Case Study 7 – Eco Smart City Project, Vietnam

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID007
INITIATIVE	Eco Smart City Project
COUNTRY	Vietnam

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	Eco Smart City Project
Case	ID007

<table>
<tr><td colspan="4">SURVEY</td></tr>
<tr><td>Sources</td><td>No</td><td>Description</td><td>Reference</td></tr>
<tr><td></td><td>1</td><td>In September 2012, the Vietnamese government launched the National Green Growth Strategy. This strategy aims to achieve low carbon emissions and enrich natural capital. In turn, these factors will be the drivers for a sustainable economic development. Vietnam is establishing a carbon market were companies can receive carbon credits to meet the obligations under the Kyoto Protocol. Vietnam and investors are creating an environmentally conscious Eco Smart City in Ho Chi Minh City - Eco Smart City project.</td><td>http://www.vietnam-briefing.com/news/vietnam-ripe-green-investment.html/
http://www.greengrowth-elearning.org/pdf/VietNam-GreenGrowth-Strategy.pdf
http://www.establishmentpost.com/vietnam-ripe-green-investment/#ixzz3X9neseUp</td></tr>
<tr><td>Highlights</td><td colspan="3">Eco Smart City project intends to be an example of modern green architecture. The projects investment is US$2 billion. The overall goals of this project are:
○ Green growth is by and for the people, contributing to employment, poverty reduction and improving the material and spiritual life of all people.
○ Green growth must lead to increased investments in conservation, development and efficient use of natural capital, reduction of greenhouse gas emissions and improvement of environmental quality, thereby stimulating economic growth.
○ Green growth must be based on science and modern technologies, which are suitable to Vietnam conditions.
○ Green growth is the cause of the entire Party, all people, every level of Government, ministries, localities, enterprises, and social organizations.</td></tr>
<tr><td>Comments</td><td colspan="3">The project is expected to start in September 2015, when the Vietnamese government celebrates 70 years of independence.</td></tr>
</table>

SURVEYOR				
Who	Nuno Vasco Lopes (researcher)			
	Mário Peixoto (editor)			
When	25 April 2015			
WHO	STAKEHOLDERS			
	Responsible Institution	Name	Vietnamese Government	
		Funder	☒ Yes ☐ No	
		Role	Coordination and management.	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	The Korea International Cooperation Agency	
		Funder	☐ Yes ☒ No	
		Role	Assistant.	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Mitsubishi / Toshiba	
		Funder	☒ Yes ☐ No	
		Role	Investor	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	South Korean Lotte	
		Funder	☒ Yes ☐ No	
		Role	Investor	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Vietnam
	State/Province	n/a
	City	Ho Chi Minh
	Region	South-Eastern Asia
	Date	2015

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">The creation of the new eco smart city Ho Chin Minh is part of the National Green Growth Strategy of Vietnam. The project aims to attract investors in the credit carbon business model.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☒ Eco City
☐ Ubiquitous City
☐ Smart City</td></tr>
<tr><td>What is About Summary</td><td>Eco Smart city project will be one example of a city where its economy development will be based on green growth investments.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovation resides on the carbon credits that companies can have in order to meet the Kyoto Protocol obligations. The credits are achieved through the use of green technologies and programs for green growth in different areas (industry, agriculture, urban areas, tax, etc.).</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The green growth strategy to achieve a sustainable economic development seems to be a good strategy because the countries and companies must meet the carbon emission limits set out by the Kyoto Protocol.</td></tr>
<tr><td>Comments</td><td colspan="2">The Eco Smart City Ho Chin Minh project has already attracted investors.</td></tr>
</table>

WHY	Drivers	☒ Economic Development	Outcome:	Restructure the economy and foster the economic institutions by greening existing sectors and encouraging the development of economic sectors to use energy and natural resources efficiently with higher added values.
		☐ Governance		
		☐ Mobility		
		☒ Environment		Reduce the greenhouse gas emissions and promote the use of clean and renewable energy.
		☒ Social Development		Conduct research: to enhance the application of advanced green technologies able to more efficiently use the natural resources; to reduce greenhouse gas emissions; and to contribute to an effective response to climate change.
		☒ Quality of Life		Improve the quality of life of its people, creating an environmentally friendly lifestyle through employment generation from green industry, agriculture and services; Investment in green spaces; Development of a green infrastructure.
	Benefits	○ Green Construction: high efficient in the use of energy and materials; ○ Urban ecology: harmonized ecosystem to improve the welfare of people; ○ Businesses in the energy sector; ○ Green products: non-toxic; ○ Green Jobs; ○ Knowledge in green growth issues.		
	Values	○ Promote collaboration for competences and skills development; ○ Foster a common collective goal within its society; ○ Promote eco-labelling and disseminate information on environmentally friendly products to the entire society; ○ Public expenditure should lead the development and use of green economy standards; ○ Encourage sustainable consumption in the business sector; ○ Sustainable consumption by the people.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	Develop strong information technology as the basic infrastructure for e-Government.
	Maturity	The maturity of the Eco Smart City project, along with the National Green Growth Strategy, described in detail the metrics that should be achieved as well as how they should be implemented, indicating that the smart city project has a good level of maturity.
	Challenges	○ Ensure a very efficient use of resources; ○ Achieve a sustainable economic development only through green practices; ○ Attract investors to green growth business; ○ Avoid the technology polarization of citizens; ○ Reduce carbon emissions.
	Risks	○ Not achieving the carbon footprint needed to be viable; ○ To be energetically self-sufficient based on renewable energies; ○ Neglect legal, social and ethical impacts of technology; ○ Security problems.
	Tools	○ Information and data systems and management tools; ○ Environmental tax and fees to adjust excessive consumption.
	Technologies	○ Green Energy Technology (economizing fossil energy, energy recirculation in industrial production, reduced emissions, solar energy, wind energy, nuclear energy, tidal energy and the systems of smart power grids, etc.); ○ Material technology and construction (includes non-fired materials, wood substitute materials, processing of traditional materials using appropriate high technology, intelligent buildings, green buildings, etc.); ○ Mechanical technology in transportation (engines using new, low emissions energy, intelligent transportation systems, etc.); ○ Green Technology for agriculture, forestry, biology (new plant varieties, cultivation and processing of agricultural, forestry and fishery); ○ Green chemical technology (production of synthetic plastics based on plant material which easily decompose, production from renewable raw materials, treatment of hazardous waste, producing little or no by-products and waste, production with little consumption of water and chemicals, etc.); ○ Waste treatment technology (waste recycling, prevention and disposal of hazardous waste).

C.3.8. Case Study 8 – Digital and Knowledge-Based City, Mexico

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID008
INITIATIVE	Digital and Knowledge-Based City
COUNTRY	Mexico

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy [i]nstruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	Digital and Knowledge-Based City
Case	ID008

SURVEY			
Sources	No	Description	Reference
	1	In 2012, the Legislation Assembly of Mexico DF penned the Law for the Development of Federal District as a Digital City and of Knowledge. This law states the right to universal, equal and affordable access to all services related with the ICTs and Technologies of Knowledge, offered by the public administrations. The law also includes guidelines to develop the Digital Mexico. The Digital Mexico promotes the use of ICT technologies as a tool for socio-economic development.	http://www.smartcbi.org/index.php/en/smart-talk/item/968-mexico/968-mexico http://www.smartscities.com/en/2-mexico-of-smart-cities.html http://www.mexicodigital.com.mx http://portaldeldesarrollo.com http://www.contraloria.df.gob.mx/index.php/innovacion-tecnologica/135-innovacion-tecnologica/1221-ciudad-de-mexico-capital-digital
Highlights	The first step to achieve Digital Mexico - a digital and knowledge city – was the law launched in 2012 together with the development plan. The second step was the elaboration of the Agenda Digital with the guidelines for Capital Digital implementation.		
Comments	Latin American cities could be a good example of smart city good practices, since they are, in a way, a forecast of what is coming for European cities during the next years, because the percentage of the population living in cities is near 80% in Latin America, already surpassing other regions usually considered as "more developed".		

SURVEYOR				
Who	Nuno Vasco Lopes (researcher)			
	Mário Peixoto (editor)			
When	26 April 2015			
WHO	STAKEHOLDERS			
	Responsible Institution	Name	Federal Administration of Mexico	
		Funder	☒ Yes ☐ No	
		Role	Coordination and management.	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Mexico
	State/Province	Mexico City DF
	City	Mexico City
	Region	Central America
	Date	2012

WHAT	AIM		
	City Background	The population of Mexico DF is larger than that of all other capitals in Latin America and the Caribbean together. The size and population of Mexico City pose tremendous challenges and difficulties to the local government. The importance of Mexico in the smart city panorama of Latin America is growing. The legal grounds have been already established with Digital and knowledge-based city plans in order to protect the concept of the Digital Mexico and the access of citizens to wireless networks and digital information.	
	Concept	Type	☐ Energy City ☒ Digital City ☐ Intelligent City ☒ Knowledge City ☐ Eco City ☐ Ubiquitous City ☐ Smart City
		What is About Summary	The Economic and Social Council of Mexico City DF made a long-term Agenda for the development of the Distrito Federal (Federal District) as a digital and knowledge-based city. The Agenda for the development of the Distrito Federal (DF) as a digital and knowledge-based city is funded by public resources that belong to the Federal Administration. The main objective of this initiative is the socio-economic development of city through the appropriate use of ICT technologies.
	Innovation(s)	The innovation aspect of this initiative is the legal framework to enforce the implementation and adoption of the Digital Mexico plan.	
	Lessons Learnt	A framework of regulations was developed to target how information and communication technologies should be used in different areas.	
	Comments		

WHY	Drivers	☒ Economic Development	Outcome:	Restructure the economy and foster the economic institutions by greening existing sectors and encouraging the development of economic sectors to use energy and natural resources efficiently with higher added values.
		☒ Governance		○ e-Government ○ e-Justice ○ e-Education ○ e-Health ○ e-Finances ○ e-Transport
		☒ Mobility		Implementation and development of Information and Communication Technologies in city transports.
		☐ Environment		
		☒ Social Development		○ Universal, equal and affordable access to services involving Information and Communication Technologies and Knowledge-based Technologies provided by the Public Administration is a right for all citizens in the DF. ○ Digital competence development will be promoted at all stages of education, training and human resources development, based on usability standards that ensure easy system management to the different target population groups, particularly those with different abilities and vulnerable groups. ○ Training and professionalization for developers of socially-oriented computer applications will be fostered.
		☒ Quality of Life		○ Affordable, reliable and high-speed Internet connection will be promoted in academic and research institutions located in the DF, in order to foster its essential function of technology and knowledge production. ○ Patient tele-monitoring, online doctor appointments and control of supplies of essential pharmaceutical drugs.
	Benefits	○ e-Government; ○ e-Justice; ○ e-Education; ○ e-Health; ○ e-Finances; ○ e-Transport; ○ Smart services for citizens and companies; ○ Security: surveillance cameras in the city; ○ Healthcare system; ○ Accelerate new business; ○ Open data: citizens have access to data sets available in a portal.		
	Values	○ Foster the engagement of citizens in the development of the knowledge society and in the management of public affair; ○ Promote knowledge-transfer; ○ Gives voice to citizens; ○ Promotes collaboration and skills development.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The e-Government model is composed by e-Administration, e-Citizen and e-Services components.
	Maturity	A self-assessment tool would be useful to measure the implementation of the plan in all of its phases. It is also missing the level of maturity when compared to other cities, however, making one empirical comparison to other smart cities, we could say that the level of maturity is reasonable.
	Challenges	○ Develop an integrated city infrastructure and platform; ○ Standards for interoperability; ○ Avoid the technology polarization of citizens; ○ Improve the economy only resorting to ICT; ○ Ensure equity and fairness.
	Risks	○ Not considering social-environmental concerns; ○ Neglect the social and ethical impact of technologies; ○ Excess of surveillance cameras could threaten citizens' privacy.
	Tools	○ Information and communication tools and platforms for public administration and city; ○ Legal framework; ○ Smart city Model; ○ e-Government; ○ e-Justice; ○ e-Education; ○ e-Health; ○ e-Finances; ○ e-Transport.
	Technologies	○ Cyber-security; ○ Technology-assisted education; ○ Wireless networks; ○ Data analysis; ○ Open data infrastructures; ○ New technologies.

C.3.9. Case Study 9 – Open Data – GXBus, Uruguay

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID009
INITIATIVE	**Open Data - GXBus**
COUNTRY	Uruguay

INTRODUCTION
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PRACTICE	
Name	**Open Data - GXBus**
Case	ID009

SURVEY			
Sources	No	Description	Reference
	1	Montevideo was the first Latin America city to have an open data policy (2010). The public data provided by Montevideo City gives rise to the creation of several new open-data application initiatives. One of them was the GXBus initiative in 2013. The GXBus mobile application gives information to users about Montevideo public transports.	http://www.opendataresearch.org/sites/default/files/publications/Opening%20Montevideo-a%20case%20studyfinalII.pdf
Highlights	GXBus is a free application for all sort of smartphone devices.		
Comments	The Uruguayan open data policy fostered the creation of new open-data applications developed either by public services or by the private sector, benefiting citizens and giving them new and ubiquitous services.		

<table>
<tr><td colspan="2">SURVEYOR</td></tr>
<tr><td rowspan="2">Who</td><td>Nuno Vasco Lopes (researcher)</td></tr>
<tr><td>Mário Peixoto (editor)</td></tr>
<tr><td>When</td><td>27 April 2015</td></tr>
</table>

<table>
<tr><td rowspan="7">WHO</td><td colspan="4">STAKEHOLDERS</td></tr>
<tr><td rowspan="6">Responsible Institution</td><td>Name</td><td colspan="2">Martin Rostagnol – Uruguayan developer</td></tr>
<tr><td>Funder</td><td colspan="2">☐ Yes ☐ No</td></tr>
<tr><td>Role</td><td colspan="2">Developer</td></tr>
<tr><td rowspan="3">Type</td><td>☐</td><td>Government</td></tr>
<tr><td>☐</td><td>Industry</td></tr>
<tr><td>☒</td><td>Non-Governmental Organization</td></tr>
</table>

<table>
<tr><td rowspan="6">WHERE</td><td colspan="2">LOCATION AND TIME</td></tr>
<tr><td>Country</td><td>Uruguay</td></tr>
<tr><td>State/Province</td><td>n/a</td></tr>
<tr><td>City</td><td>Montevideo</td></tr>
<tr><td>Region</td><td>South America</td></tr>
<tr><td>Date</td><td>2013</td></tr>
</table>

<table>
<tr><td rowspan="7">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Montevideo is the capital of Uruguay. It houses more than half of the country's 3.3 million people. It is the heart of the growing industry and it is expanding its shared services sector and growing the interest in Finance and Accounting Outsourcing. In Uruguay, most of the population and labor force is concentrated in the Montevideo metropolitan area (61%), and all global services companies are located in this city.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>The open-data application goal is to provide Montevideo citizens a tool to navigate in the city transport system, giving them information about how to reach a destination and when the bus arrives at the box station.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovative aspect of this initiative is the fact of being a bottom-up smart city approach that was initiated by citizens due to the fact that they needed it.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">This is a good example of one initiative driven by specific citizen needs and developed by them.</td></tr>
<tr><td>Comments</td><td colspan="2"></td></tr>
</table>

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☒ Mobility		More than 5000 applications are installed in Android and OsX smartphones and it has more than 3500 fans in Facebook. Facebook is also a channel to provide information to citizens.
		☐ Environment		
		☐ Social Development		
		☐ Quality of Life		
	Benefits	○ Ubiquitous access; ○ More efficient use of public transport; ○ Real-time information about public transports; ○ Convenience.		
	Values	○ Increases the quality of public transport services; ○ Could have economic impact because the number of public transport users trends to increase with this application; ○ Improves society mobility in the city.		

HOW	Approach	☐ Top-Down (Government-Driven) ☒ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	Although the smart city model, in this case, is only applicable to the transport domain, due to the fact that it is a bottom-up approach and because of the open data policy, its maturity in terms of smart city initiatives is high.
	Challenges	○ Maintain the application and data sets; ○ Standards for interoperability; ○ Avoid the technology polarization of citizens; ○ Ensure equity and fairness.
	Risks	○ Neglect other public transport information alternatives for none IT users; ○ Dependence on ICT technology.
	Tools	○ GXBus
	Technologies	○ Telecom networks; ○ Open data infrastructures; ○ New technologies; ○ Mobile devices.

C.3.10. Case Study 10 – Chamber Campaign, Colombia

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0010
INITIATIVE	**Chamber Campaign**
COUNTRY	Colombia

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Chamber Campaign**
Case	ID0010

SURVEY			
Sources	No	Description	Reference
	1	In the spring of 2011, the chamber campaign of Bogotá was launched and involved several online initiatives to engage the population in the reinvention of the city. As a result of these initiatives, the population delivered five proposals to be included in the new mayor's agenda.	http://socialmediaweek.org/blog/2012/09/engaging-the-population-of-a-city-to-reinvent-itself-part-two/
Highlights	To engage the citizens beyond face-to-face roundtables, the candidates used a broad sort of online tools, such as Facebook, Twitter, forums, blogs, and virtual questionnaires.		
Comments	More than 10.000 citizens have been actively involved in the Chamber's process and over 28 million hits have been made on websites about the campaign.		

SURVEYOR			
Who	Nuno Vasco Lopes (researcher)		
	Mário Peixoto (editor)		
When	27 April 2015		
WHO	STAKEHOLDERS		
	Responsible Institution	Name	Not applicable
		Funder	☐ Yes ☐ No
		Role	Developer
		Type	☐ Government
			☐ Industry
			☒ Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Colombia
	State/Province	n/a
	City	Bogotá
	Region	South America
	Date	2011

WHAT	AIM		
	City Background	Bogotá is the capital of Colombia and has a population of about 7.5 million people. The city economy is developed and diversified. Its commercial and business activities are increasing significantly. The main financial and banking centres of Colombia are located in Bogotá.	
	Concept	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	During Bogotá's campaign of 2011 the candidates have used several online tools to involve and engage the citizens in the re-construction of city. The result was one massive citizen participation, which gives light to five consensual proposals for the agenda of the next Mayor.
	Innovation(s)	This initiative has the innovation of contributing to cultivate values like citizen participation and citizen engagement in the city policies.	
	Lessons Learnt	This is a good example of one citizen-driven initiative that provides a consensual way to build a smart city.	
	Comments		

WHY	Drivers	☐ Economic Development	Outcome:	
		☒ Governance		Five proposals have been made by citizens to Mayor's agenda.
		☐ Mobility		
		☐ Environment		
		☐ Social Development		
		☐ Quality of Life		
	Benefits	o Engage the citizens in the city development strategy; o Cultivate good social values.		
	Values	o Promotes consensus-building; o Enriches social interactions; o Decision-making through consensus-building; o Gives voice to citizens; o Fosters common collective goals.		

HOW	Approach	☐ Top-Down (Government-Driven) ☒ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	This case represents a significant shift in the process of building a political agenda because citizens settled the political agenda. Therefore, the maturity of this initiative is advanced.
	Challenges	o Follow the agenda that was agreed with the citizens.
	Risks	o Neglect the citizens' proposals because of personal or political interests.
	Tools	o Facebook; o Twitter; o Forums; o Blogs; o Virtual questionnaires.
	Technologies	o Telecom and data networks; o Web technologies; o Mobile devices.

C.3.11. Case Study 11 – Large Outdoor Escalator System, Colombia

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0011
INITIATIVE	**Large Outdoor Escalator System – Medellin**
COUNTRY	Colombia

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Large Outdoor Escalator System – Medellin**
Case	ID0011

SURVEY			
Sources	No	Description	Reference
	1	The large outdoor escalator built in Medellin connects the poor neighborhoods to the prosperous city's valley center. The system reduced the travel time from half an hour to just 6 minutes.	http://www.opendataresearch.org/sites/default/files/publications/Opening%20Montevideo-a%20case%20studyfinalII.pdf http://www.amusingplanet.com/2015/03/massive-outdoor-escalator-in-comuna-13.html
Highlights	This is a very concrete action to improve the quality of life of the most needed citizens.		
Comments	The escalator is divided into six stages and zigzags its way up the slope ascending a total height of 384 meters.		

SURVEYOR			
Who	Nuno Vasco Lopes (researcher)		
	Mário Peixoto (editor)		
When	27 April 2015		

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Medellin government	
		Funder	☒ Yes ☐ No	
		Role	Management and developer.	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	Colombia
	State/Province	n/a
	City	Medellin
	Region	South America
	Date	2011

	AIM		
WHAT	City Background	The neighborhood of Comuna 13, located on the periphery of Medellin, is one of the poorest in the city. Crime and gang war gained the upper hand, and Comuna 13 became known as the most violent neighborhood in the city of Medellin. For several years, approximately 12.000 dwellers of Comuna 13 used to climb hundreds of steps to get from the city center to their homes.	
	Concept	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	The initiative is about the installation of an urban escalator system in a poor neighborhood of Medellin that cuts an arduous 30-minute walk to a 6-minute walk.
	Innovation(s)	The innovation here is the escalator system designed and implemented for use by residents of a poor area.	
	Lessons Learnt	A "simple" and innovator public transportation system like an escalator could have a profound impact in the life of citizens.	
	Comments		

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☒ Mobility		Improve mobility of people in peripheral areas (mountains) through large outdoor escalator system.
		☐ Environment		
		☐ Social Development		
		☒ Quality of Life		
	Benefits	○ Improves the quality of life; ○ It is safer than walking; ○ Offers more commodity.		
	Values	○ Promotes equity and fairness among citizens; ○ Addresses the most needed citizens; ○ Improves society mobility in the city.		

HOW	Approach	Top-Down (Government-Driven) Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	The initiative is mature.
	Challenges	Maintain the escalator always available; Avoid equipment misuse.
	Risks	Security issues mainly related to children and elderly.
	Tools	Escalator system.
	Technologies	Mobility technologies.

C.3.12. Case Study 12 – Integrated Transportation Network, Brazil

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0012
INITIATIVE	Rede Integrada de Transporte (Integrated Transportation Network)
COUNTRY	Brazil

INTRODUCTION

This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development.

In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice:

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2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development.
3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt.
4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life.
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others.

This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	Rede Integrada de Transporte (Integrated Transportation Network)
Case	ID0012

SURVEY			
Sources	No	Description	Reference
	1	The Integrated Transportation Network allows a citizen to use more than one line with only one ticket. The public transport system has integration terminals to connect different lines so that users could easily change between lines.	http://www.urbs.curitiba.pr.gov.br/transporte/rede-integrada-de-transporte
Highlights	The system removes the typical delay in the transition between lines. It is flexible, low cost and simple to use as a traditional bus system.		
Comments	Curitiba was the first city in the world to implement a BRT system (1974).		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	27 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	URBS - Urbanização de Curitiba S.A	
		Funder	☒ Yes ☐ No	
		Role	Planning, operation and control	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Fundação Bamerindus de Assistência Social	
		Funder	☒ Yes ☐ No	
		Role	Shareholder	
		Type	☐	Government
			☐	Industry
			☒	Non-Governmental Organization
	Partner	Name	HSBC Seguros (Brasil) S/A	
		Funder	☒ Yes ☐ No	
		Role	Shareholder	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Banestado S/A, Participações, Administração e Serviços	
		Funder	☒ Yes ☐ No	
		Role	Shareholder	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

<table>
<tr><td rowspan="6">WHERE</td><td colspan="2">LOCATION AND TIME</td></tr>
<tr><td>Country</td><td>Brazil</td></tr>
<tr><td>State/Province</td><td>Paraná State</td></tr>
<tr><td>City</td><td>Curitiba</td></tr>
<tr><td>Region</td><td>South America</td></tr>
<tr><td>Date</td><td>1974</td></tr>
</table>

<table>
<tr><td rowspan="7">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Curitiba is a Brazilian city with approximately 1.9 million people and it is the capital of the Paraná state. The urban growth rate strengthened by the arrival of a lot of European immigrants throughout the nineteenth century: mainly Germans, Poles, Ukrainians and Italians, which contributed to the cultural diversity that remains today. The city experienced several urban plans and laws aimed at promoting their international famous growth in urban innovations and environment development.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>It is about a public transport system that has been specially designed to improve system quality and efficiency, and to remove the traditional delays found in traditional bus systems.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The main innovator features of the Rede Integrada de Transporte:
○ Dedicated lanes;
○ Busway alignment;
○ Off-board fare collection;
○ Intersection treatment;
○ Platform-level boarding.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The main objective of this system is to reduce the delays in the urban public-transit platform.</td></tr>
<tr><td>Comments</td><td colspan="2">There are similar systems around Brazil and other countries, such as the TransMilenio in Porto Alegre, São Paulo and Bogotá, some of them with other innovations such as passing lanes and express service.</td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☐ Economic Development</td><td rowspan="6">Outcome:</td><td></td></tr>
<tr><td>☐ Governance</td><td></td></tr>
<tr><td>☒ Mobility</td><td>To be a reference in innovative solutions and efficient in the urban mobility management.</td></tr>
<tr><td>☐ Environment</td><td></td></tr>
<tr><td>☐ Social Development</td><td></td></tr>
<tr><td>☒ Quality of Life</td><td>Improve urban life.</td></tr>
<tr><td>Benefits</td><td colspan="3">o More efficient, safe and accessible public transports;
o More quality of life;
o Reduce the risk of accidents.</td></tr>
<tr><td>Values</td><td colspan="3">o Honesty in the conduct of our activities and business;
o Responsibility for our actions;
o Respect for people;
o Transparency in our actions.</td></tr>
</table>

<table>
<tr><td rowspan="7">HOW</td><td>Approach</td><td>☐ Top-Down (Government-Driven)
☒ Bottom-Up (Citizen-Driven)</td></tr>
<tr><td>Governance</td><td>Not applicable</td></tr>
<tr><td>Maturity</td><td>As the project exists since 1974 it has a high level of maturity.</td></tr>
<tr><td>Challenges</td><td>o Supervise;
o Enhance the mobility system for people with disabilities;
o Reduce air pollution;
o Extend the system to all communities;
o Customer satisfaction.</td></tr>
<tr><td>Risks</td><td>o Failing to collect income;
o Overloaded vehicles;
o Personal safety;
o Long waits;
o Inconvenient location of stations.
o Low service frequency;
o Too expensive.</td></tr>
<tr><td>Tools</td><td>o Bus Rapid Transit.</td></tr>
<tr><td>Technologies</td><td>o Vehicle prioritization;
o Vehicle to Infrastructure communication (V2I);
o Vehicle to Vehicle communication (V2V);
o Fare collection;
o Operation management technologies;
o Technologies for providing information to passengers (PDAs, Smartphones, etc.);
o Databases and data analysis;
o Mobile devices.</td></tr>
</table>

C.3.13. Case Study 13 – Sustainable Barcelona Map Project, Spain

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0013
INITIATIVE	Sustainable Barcelona Map Project
COUNTRY	Spain

INTRODUCTION

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In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice:

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4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life.
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others.

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PRACTICE	
Name	Sustainable Barcelona Map Project
Case	ID0013

SURVEY			
Sources	No	Description	Reference
	1	Sustainable Barcelona Map is a virtual interactive map linked to the Open Green Map. It is also a social network for smartphones, which includes socio-environmental initiatives relevant to the city. Specifically, the map provides practical information about interest points (such as shopping, accommodation, equipment, and infrastructure), signposted with QR codes and citizen experiences (stories, photographs, and activities) of the city.	http://smartcity.bcn.cat/en/bcn-smart-city.html
Highlights	The Sustainable Barcelona Map gives visibility to the contributions that citizens make to improve their city, from small and emerging initiatives to large projects. It is also a tool for community recognition, communication and awareness.		
Comments	It is a participatory project that aims to promote the sustainability of the city and strengthen the public network in Barcelona.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	27 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	Catalan Society for Environmental Education (SCEA), Centre for Research and Information on Consumption (CRIC) and municipal center of the Sun Factory (LFdS)	
		Funder	☐ Yes ☒ No	
		Role	Creators	
		Type	☐	Government
			☐	Industry
			☒	Non-Governmental Organization
	Partner	Name	Environmental and Social Agents	
		Funder	☒ Yes ☐ No	
		Role	Coordinators	
		Type	☐	Government
			☐	Industry
			☒	Non-Governmental Organization
	Partner	Name	Citizens	
		Funder	☐ Yes ☐ No	
		Role	People who participate in collaborative mapping	
		Type	☐	Government
			☐	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Spain
	State/Province	n/a
	City	Barcelona
	Region	Southern Europe
	Date	2012

WHAT	AIM		
	City Background	Barcelona's Smart City Strategy has a holistic view of the city, comprising several projects that resort to technology as a transversal tool to manage the city resources and services in a more efficient way. The final goal is to achieve a sustainable social, economic and urban development, thereby improving the quality of life of its citizens. After an extensive consultation process, Barcelona took shape in its Agenda 21 Commitment towards Sustainability from 2002 to 2012, a document that defined broadly agreed principles, objectives and lines of action to move towards a better city. During this time, Barcelona have evolved ideas about what is good for the city and how to achieve it, several collaborative projects have started and unquestionable progress has been achieved. In 2012, Barcelona redefined its commitment to Sustainability citizen, marking the roadmap toward a more equitable, prosperous and self-sufficient for the next 10 years.	
	Concept	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	The project is about a participatory tool composed by an interactive virtual map and a social network, which allows the introduction of city initiatives and places of interest for environment sustainability and social value.
	Innovation(s)	The innovative aspect of this project is the fact that the content of the new map is being created through collaborative workshops. The tool is also being used as a teaching resource and to promote student participation.	
	Lessons Learnt	This project goes beyond simply engaging citizen participation in the creation of a sustainable city; it also adds social value because it can be used as a pedagogical tool for transmitting environmental awareness to the community.	
	Comments	This project also contributes for the international initiative "Open Green Map".	

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☐ Mobility		
		☒ Environment		o Encouraging responsible behavior sustainable mobility, production and responsible consumption, respect for natural and cultural heritage, etc. o Being a reference portal for citizenship and become a normal element of consultation of the natural and social tool to boost the green economy. o Having a tool open to the public and the dynamism of the transformation of the city, picking and highlighting the experiences and knowledge of the environment of residents.
		☐ Social Development		o Advancing social and business commitment towards a sustainable and collaborative culture, creating spaces for community exchanges, participation and meetings in the territory.
		☐ Quality of Life		
	Benefits	o Gives information about sustainable shops, services and businesses, environmental facilities, fauna and flora wildlife refuges, and so on; o Connects the city to work together for a sustainable development; o Contributes to improving the urban environment; o Publicizes spaces and highlights the environmental heritage attractions.		
	Values	o Sustainability; o Responsibility; o Equity; o Inclusion; o Innovation; o Transparency; o Proximity.		

HOW	Approach	☐ Top-Down (Government-Driven) ☒ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	The tool promotes the engagement of citizens in the creation of a more sustainable city and adds social value, which makes the initiative mature.
	Challenges	o Involve the community in the production of content; o Be able to add cultural and social value; o Avoid the technology polarization of citizens; o Ensure equity and fairness.
	Risks	o Discriminate the non-technological citizens; o Dependence on ICT technology.
	Tools	o Virtual Map
	Technologies	o Internet; o Virtual maps; o Open data infrastructures; o Mobile devices.

C.3.14. Case Study 14 – Skolkovo Project, Russia

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0014
INITIATIVE	Skolkovo Project
COUNTRY	Russia

INTRODUCTION
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PRACTICE	
Name	**Skolkovo Project**
Case	ID0014

SURVEY			
Sources	No	Description	Reference
	1	The Skolkovo Project goal is to create a smart city that is an international innovation center. The initiative started in 2010 as a state project to modernize and develop Russian economy by reducing its dependence on oil and gas, and to become a knowledge-innovation based economy.	http://sk.ru/city/ http://www.urenio.org/2015/03/05/smart-city-strategy-skolkovo-russia/ https://www.youtube.com/watch?v=J0oo2S-XRQ0
Highlights	The city's master plan principles are focused on environmental sustainability, a city with minimal or zero emissions, total waste recycling, a developed water system, the prohibition to use vehicles with combustion engines in the city centre, use of renewable energies and walking and cycling as prioritized transport systems.		
Comments	The ambitious project intends to be the "Silicon Valley" of Russia.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	27 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	Russian government	
		Funder	☒ Yes ☐ No	
		Role	Developer	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Cisco Systems	
		Funder	☒ Yes ☐ No	
		Role	Planning and implementation of technology infrastructure	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	French company AREP	
		Funder	☐ Yes ☒ No	
		Role	Developer of the general plan	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Russia
	State/Province	n/a
	City	Skolkovo
	Region	Eastern Europe
	Date	2010

WHAT	AIM		
	City Background	The Skolkovo Innovation Center is a 10-year planned city for 20.000 residents that is going to be built just outside Moscow.	
	Concept	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	It is about the creation of an innovation hub or centre in Russia, which will be built accordingly to smart city sustainable principles.
	Innovation(s)	The innovative aspect of this initiative is the fact of being a bottom-up smart city approach that was initiated by citizens because they needed it.	
	Lessons Learnt	This is a good example of one initiative driven by specific citizen needs and developed by them.	
	Comments		

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒ Economic Development</td><td rowspan="6">Outcome:</td><td>Stimulate innovation in information and communications technologies, biotechnologies, aerospace, energy efficiency technologies, and nuclear technology.</td></tr>
<tr><td>☐ Governance</td><td></td></tr>
<tr><td>☐ Mobility</td><td></td></tr>
<tr><td>☒ Environment</td><td>○ Minimal or zero emissions of environmentally harmful substances;
○ Recourses are managed prudently (buildings will use about 30% less electricity, heat and water than the average Russian ones);
○ All waste is recycled;
○ At least 50% of the energy comes from renewable recourses.</td></tr>
<tr><td>☐ Social Development</td><td></td></tr>
<tr><td>☐ Quality of Life</td><td></td></tr>
<tr><td>Benefits</td><td colspan="3">○ Reduces the dependence of Russia on oil and gas;
○ Leverages human capital;
○ Creates new academic institutions;
○ Creates congress centres;
○ Creates offices and laboratory buildings;
○ Builds new apartments;
○ Creates fitness centres;
○ Creates stores.</td></tr>
<tr><td>Values</td><td colspan="3">○ Promotes entrepreneurial culture;
○ Promotes an environmentally sustainable culture;
○ Innovation.</td></tr>
</table>

<table>
<tr><td rowspan="7">HOW</td><td>Approach</td><td>☒ Top-Down (Government-Driven)
☐ Bottom-Up (Citizen-Driven)</td></tr>
<tr><td>Governance</td><td>Not applicable</td></tr>
<tr><td>Maturity</td><td>Currently, the city is being implemented, however, the major part of the investment remains to be done. The maturity of the Smart City model is low, the citizens are not taken into account.</td></tr>
<tr><td>Challenges</td><td>○ Stimulate the economic development;
○ Attract investment;
○ Reduce oil and gas dependency;
○ Leverage human capital;
○ Ensure equity and fairness.</td></tr>
<tr><td>Risks</td><td>○ Initiative driven only by strategic and political interests;
○ Neglect legal and social impact;
○ Cultural barrier (e.g. transparency).</td></tr>
<tr><td>Tools</td><td>○ Smart city master plan.</td></tr>
<tr><td>Technologies</td><td>○ Information and communication technologies;
○ Cisco technologies;
○ Virtualization.</td></tr>
</table>

C.3.15. Case Study 15 – Living Lab, Netherlands

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0015
INITIATIVE	Living Lab
COUNTRY	Netherlands

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	Living Lab
Case	ID0015

SURVEY			
Sources	No	Description	Reference
	1	Amsterdam created a partnership between businesses, authorities, NGOs and citizens to develop the Amsterdam Smart City (ASC). ASC has several projects, which are organized in eight domains: smart mobility, smart living, smart society, smart areas, smart economy, Big&Open Data, Infrastructure, and Living Labs. For this case study, we decided to select the IJburg Living Lab. For this initiative, ASC together with IJburg dwellers, developed new products and services, such as transport, work, healthcare or energy, in order to improve the quality of life in the IJburg district. The projects that are being developed in IJburg are Free Wi-Fi, Fiber-to-the-Home, IJburg YOU decide! Ring-Ring, Smart Work@IJburg, Digital Road Authority-Incident Management, and Wijk TV.	http://amsterdamsmartcity.com/projects/living-labs
Highlights	The young population, high-level connectivity and modern surroundings give to IJburg the ideal ingredients to be an excellent area for the development of new products and services.		
Comments	The philosophy behind the development of new products and services is always based on the user needs.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	27 April 2015

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Alliander	
		Funder	☒ Yes ☐ No	
		Role	Founder	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Amsterdam Economic Board	
		Funder	☐ Yes ☒ No	
		Role	Founder	
		Type	☐	Government
			☐	Industry
			☒	Non-Governmental Organization
	Partner	Name	ARCADIS	
		Funder	☒ Yes ☐ No	
		Role	Founder	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization
	Partner	Name	Gemeente Amsterdam	
		Funder	☒ Yes ☐ No	
		Role	Founder	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	Netherlands
	State/Province	n/a
	City	Amsterdam
	Region	Western Europe
	Date	2010

<table>
<tr><td rowspan="11">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">The neighborhood of IJburg is the youngest district of Amsterdam. Only in the late 90's was taken the decision to start building this neighborhood. IJburg has been developed with houses that are suitable for families, which means that the overall population is very young. IJburg also has young and modern infrastructures, for instance, dwellers have access to the fastest public fiber optic broadband Internet in the world.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>It is about an urban living lab in the IJburg district that allows businesses the potential to both test and demonstrate innovative products and services.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovative aspect of this initiative is the fact that the new products and services can be developed and tested in a real scenario.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">Living labs are a very useful tool to test innovative solutions. These, in turn, will allow people to know which are the best practices to implement and use a given product or service.</td></tr>
<tr><td>Comments</td><td colspan="2"></td></tr>
</table>

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☐ Economic Development</td><td rowspan="6">Outcome:</td><td></td></tr>
<tr><td>☐ Governance</td><td></td></tr>
<tr><td>☐ Mobility</td><td></td></tr>
<tr><td>☐ Environment</td><td></td></tr>
<tr><td>☐ Social Development</td><td></td></tr>
<tr><td>☒ Quality of Life</td><td>Improve the quality of life</td></tr>
<tr><td>Benefits</td><td colspan="3">○ Connecting parties and building consortiums;
○ Identifying local investment portfolios and connecting to them;
○ Gaining knowledge about dwellers and users of neighborhoods;
○ Identifying the needs and wishes of the dwellers and users of neighborhoods;
○ Energy potential analysis: technical, demographic and urban planning insights into the present and potential energy consumption of neighborhoods;
○ Knowledge exchange based on previous pilot projects;
○ Can be replicated.</td></tr>
<tr><td>Values</td><td colspan="3">○ Takes into account the region needs;
○ Promotes an environmentally sustainable culture;
○ Innovation;
○ Knowledge-transfer;
○ Local citizens;
○ Empower participation and co-creation;
○ Do-it-yourself.</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	ASC partnership of Amsterdam has an advanced and holist view of the smart city implementation with several projects organized by areas already implemented. The initiative is very mature.
	Challenges	○ Have a good methodology for collaborations; ○ Engage companies in the Living Lab experimentation; ○ Set up policy measures to be analyzed; ○ Contextualize experiments.
	Risks	○ Not having an adequate methodology for urban research; ○ The participants in living labs experiences could not represent the general society; ○ Only be used for research purposes by researchers.
	Tools	○ Living lab.
	Technologies	○ All the technologies used to build the city infrastructure.

C.3.16. Case Study 16 – Built Smart Program, USA

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0016
INITIATIVE	**Built Smart Program**
COUNTRY	United States

INTRODUCTION

This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development.

In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice:

1. Who developed the practice? The question determines the institution developing the practice as well as its partners.
2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development.
3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt.
4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life.
5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others.

This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Built Smart Program**
Case	ID0016

SURVEY			
Sources	No	Description	Reference
	1	The Built Smart Program aims to guide the design and conception of green, healthy, and comfortable buildings. The program also provides incentives for builders, developers and architects to construct energy efficient buildings. The buildings should provide resource conservation and maximum cost-efficient comfort. Every Built Smart building is subject to a rigorous inspection during the construction to check whether or not they are following the Built Smart standards.	http://www.seattle.gov/light/conserve/resident/cv5_bs.htm
Highlights	The Built Smart standards are the State building code for energy efficiency and comfort.		
Comments	The Built Smart certification guarantees that the buildings meet the requirements of standards.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	29 April 2015

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Washington	
		Funder	☒ Yes ☐ No	
		Role	Program	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Seattle City Light	
		Funder	☐ Yes ☒ No	
		Role	Administrator	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	United States
	State/Province	Washington
	City	Seattle
	Region	Northern America
	Date	2007

	AIM		
WHAT	City Background	Seattle is a port city in the US state of Washington. It is the most populous and most densely populated city in the state of Washington with a population of approximately 650.000 people. Seattle is frequently claimed as one of the smartest city in the country. It is very well ranked in the smart economy and smart government domains. The city is also recognized for promoting sustainable development, fostering start-ups, and attracting entrepreneurial talent.	
	Concept	Type	☐ Type ☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	It is a set of standards for the building industry construct sustainable buildings.
	Innovation(s)	The innovative aspect of this initiative is its regulatory aspect, which enforces the construction of green buildings.	
	Lessons Learnt	The development of mandatory policies could be an efficient tool to accelerate smart city implementations.	
	Comments	Seattle advocates that creating regulations is the key to build green buildings.	

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☐ Mobility		
		☒ Environment		○ Measure the environmental impact of buildings; ○ Construction inspection; ○ Sustainable buildings.
		☐ Social Development		
		☒ Quality of Life		Improve the quality of life.
	Benefits	○ Sustainable site development; ○ Water savings; ○ Energy efficiency; ○ Materials selection and indoor environmental quality; ○ Comfort.		
	Values	○ Innovation; ○ Environmental culture.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	The initiative has a self-assessment tool to measure the environmental impact of the construction. The initiative is mature.
	Challenges	○ Cost-effective and comfortable buildings; ○ Provide enough financial bonus for the private sector.
	Risks	○ Excess of bureaucracy; ○ The incentives may be insufficient to promote the best practices; ○ Increasing the final price of construction.
	Tools	○ Regulatory standards.
	Technologies	○ Green construction technologies.

C.3.17. Case Study 17 – New York City 311, USA

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0017
INITIATIVE	**NYC 311**
COUNTRY	United States

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	NYC 311
Case	ID0017

SURVEY			
Sources	No	Description	Reference
	1	New York City 311 is a centralized and all-purposed customer service center for New York citizens' access to non-emergency municipal services. The service is available 24 hours a day and seven days a week.	http://www.seattle.gov/light/conserve/resident/cv5_bs.htm

Highlights	○ Services most requested by New York citizens: ○ Pay a Parking Ticket; ○ NYC Jobs; ○ Affordable Housing; ○ Alternate Side Parking or Street Cleaning; ○ Property Records; ○ Civil Service Exams; ○ Food Stamps; ○ Birth Certificate; ○ IDNYC Municipal ID Card; ○ Parking Ticket Assistance; ○ Public Assistance or Welfare; ○ Noise from Neighbour; ○ Residential Maintenance Complaint.
Comments	○ The New York citizens have available for download a NYC 311 application for Android or iOS operating systems that allow them to easily find government services or report service requests to 311.

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	29 April 2015

WHO	STAKEHOLDERS			
	Responsible Institution	Name	New York government	
		Funder	☒ Yes ☐ No	
		Role	Management and implementation	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Accenture	
		Funder	☐ Yes ☒ No	
		Role	Advisor	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	United States
	State/Province	New York
	City	New York
	Region	Northern America
	Date	2003

WHAT	AIM		
	City Background	New York city is the biggest and more populous city of the United States, with a large and complex governance system. It counts with more than 350.000 employees and more than 120 agencies, offices and organizations that offer public services. In total approximately 40.000 services are provided to 8.4 million dwellers.	
	Concept What is About Summary	Type	☐ Energy City ☐ Digital City ☐ Intelligent City ☐ Knowledge City ☐ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	It is about a non-emergency public service call request through a simple and easy to remember 311 phone number. The service operator can answer calls or redirect them to information or resources that citizen need.
	Innovation(s)	The innovative aspect of this initiative is the fact that a citizen can access all city services through a single entry point by making one simple phone call.	
	Lessons Learnt	Besides the complexity of its implementation, the idea is very simple and the benefits for citizens are immense.	
	Comments	The idea is being replicated in other cities all over the world.	

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☐ Economic Development</td><td rowspan="6">Outcome:</td><td></td></tr>
<tr><td>☒ Governance</td><td>The center represents nearly 300 city, state and federal agencies that combined offer nearly 4.000 services.
More than 400 call center representatives answer calls 24x7x365.
Information is available in more than 170 languages, from Amharic to Zulu.
On an average weekday, more than 60.000 customers dial 311, and the majority of calls are handled in four minutes or less.
Visits to 311 Online, launched in 2009, total nearly seven million, and more than 300.000 text sessions have been supported since 2011.
85 percent of calls are answered in 30 seconds or less, with an average answer speed of 30 seconds.
A full 85 percent of 311 customers have their inquiry resolved during their initial call.
The NYPD is better informed about citizen quality of life issues or complaints.
New York City has saved money from the consolidation of agency call centers and expects to save millions more over the long term.</td></tr>
<tr><td>☐ Mobility</td><td></td></tr>
<tr><td>☐ Environment</td><td></td></tr>
<tr><td>☐ Social Development</td><td></td></tr>
<tr><td>☐ Quality of Life</td><td></td></tr>
<tr><td>Benefits</td><td colspan="3">Reduce burden on 911 calls;
Eliminate duplicated service;
Filling gaps in the service;
Directing resources to areas of need;
Allowing agencies to focus in their mission;
Improving agency efficiency and service delivery;
Excellence in customer satisfaction;
Hosting all New York agencies and departments;
Citizen comfort, quality of service and efficiency.</td></tr>
<tr><td>Values</td><td colspan="3">Innovation;
Increasing citizens’ sense of belonging.</td></tr>
</table>

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The governance and service delivery is centralized, effective, open and collaborative.
	Maturity	The initiative is mature because it has a well-defined governance and service model.
	Challenges	Updating services; Training qualified people to be service operators; Have appropriated technology at the right time; Limited funding and bureaucratic procedures in organizations.
	Risks	Lack of interoperability; Interdepartmental and Intradepartmental conflicts; Not having an adequate legal system; Budgets cuts; Low adaptation and flexibility capacity; Weak organizational leadership.
	Tools	Customer service centre.
	Technologies	Internet; Mobile applications; Information and communication technologies; Telecom network; Customer Relationship Management (CRM) system; Service Level Agreements (SLSs).

C.3.18. Case Study 18 – Ciudad Creativa Digital Project, Mexico

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0018
INITIATIVE	Ciudad Creativa Digital (CCD) Project
COUNTRY	Mexico

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Ciudad Creative Digital (CCD) Project**
Case	ID0018

SURVEY			
Sources	No	Description	Reference
	1	Ciudad Creative Digital (CCD) project aims to create an environment capable of generate knowledge, enhance quality of life, foster talent and innovative ideas through the intensive use of new technologies, in the Guadalajara city.	http://ccdguadalajara.com/ http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=38688452
Highlights	Guadalajara is strategically very well located, only a couple of hours away from the United States and with access to both the Atlantic and Pacific coasts. It has been used as a gateway to South America, which has allowed Guadalajara to develop further in the areas of information technology and creativity. Mexico is also a great producer of audio-visual Spanish content, generating content to the entire world and a big fan and consumer of video games.		
Comments	The project harnesses the local context and characteristics of Guadalajara to fuel strategic endeavors and develop its economy in a sustainable way.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	1 May 2015

	STAKEHOLDERS			
WHO	Responsible Institution	Name	Mexican Federal Government	
		Funder	☒ Yes ☐ No	
		Role	Define the strategy	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Ayuntamiento de Guadalajara	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	JALISCO – Gobierno Del Estado	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Camara de Comercio - Guadalajara	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	Mexico
	State/Province	Jalisco
	City	Guadalajara
	Region	Central America
	Date	2014

<table>
<tr><td rowspan="7">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">The city of Guadalajara, the capital city of the State of Jalisco, is home to approximately 40% of the information and communication technologies (ICT) industry of Mexico, as a result of a pioneering and long term industrial, scientific and technological policies that began in the 1970s. Currently, Guadalajara is one of the most important ICT hubs in Latin America, hosting international and national companies in the following subsectors: semiconductors, embedded systems, software development, systems integration, business process outsourcing, multimedia (2D and 3D), visual special effects, videogames, testing, emulation, and simulation, with more than 90.000 employees. Another strength is related with its unusually large and strong network of colleges and universities.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☒ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☐ Smart City</td></tr>
<tr><td>What is About Summary</td><td>It is about the creation of an ideal city for learning, creating and generating innovative solutions for the audiovisual industry. The goal is to develop a dynamic and creative ecosystem as a catalyst for economy growth.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovation resides on the focus of creating an urban environment that attracts the world's brightest talents in advertising, gaming, filming, TV, and other areas related with digital-media innovation.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">This is a good example of a smart city project that takes opportunity of the city's strengthens to empower the economy and offer quality of life in harmony with its historic heritage.</td></tr>
<tr><td>Comments</td><td colspan="2"></td></tr>
</table>

WHY	Drivers	☒ Economic Development	Outcome:	The Digital Creative City is intended to boost economic growth and productivity in the country as a whole, beyond its local positive effects on the economy of the State of Jalisco and the City of Guadalajara, in the sense of creating a long-term sustainable engine of growth for the economy.
		☒ Governance		Consolidating a governance model and execution mechanism for the development of the project; detailing and planning a strategy for private sector involvement in the development of the project; supporting complementary studies that will help prioritize actions and set up mechanisms for enterprise creation and talent development.
		☒ Mobility		Guarantee greater urban mobility and accessibility.
		☒ Environment		The outcome is that the community finds in city parks a sustainable and green space that is both innovative and enjoyable.
		☒ Social Development		Create an environment that attracts and preserves the right environment for companies, institutions, and creative people.
		☒ Quality of Life		Create a high quality urban model of living that seamlessly integrates adequate zoning for mixed uses such as living, digital audiovisual production, commerce, and entertainment.
	Benefits	○ Having a cluster of creative enterprises; ○ Generating 15.000 jobs primarily for young professionals; ○ Regeneration of its historic city center ; ○ Creating a model for sustainable urban growth; ○ Renovation of the underlying infrastructures; ○ Provides better services; ○ Provides new economic opportunities;		
	Values	○ Innovation and creativity; ○ Sensory experience.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The objective of the project is to have a governance model and execution mechanism tailored for Mexico, including organization, roles, business processes, rules for decision-making, project management, monitoring, and evaluation.
	Maturity	The project is well design and contextualized, it demonstrates maturity at all levels of the smart city concept.
	Challenges	○ Set up a governance model that combines the vision, needs and resources from the federal, state and municipal government, private sector, academia and civil society; ○ Establish a distributed execution mechanism, where different institutions may implement different projects in a coordinated fashion; ○ Define the role of the private sector in the development: where, when and how.
	Risks	○ The complexity of the project; ○ Align all its components; ○ Technical cooperation; ○ Management and coordination.
	Tools	○ Master Plan – Plan Maestro de Guadalajara – Ciudad Creativa Digital
	Technologies	○ Internet of Things; ○ Data Center; ○ Information and communication technologies; ○ Telecom network.

C.3.19. Case Study 19 – Wise City Initiative, China

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0019
INITIATIVE	**Wise City Initiative**
COUNTRY	China

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Wise City Initiative**
Case	ID0019

SURVEY			
Sources	No	Description	Reference
	1	Wise City initiative aims to retain people and their talent in the city by introducing innovative and creative technological solutions, as well as, became a smart city with a high level of quality of life. In addition, Hong Kong has the objective to become a smart city model.	http://www.wisecity.hk/project http://www.digital21.gov.hk/eng/relatedDoc/download/2014D21S-booklet.pdf http://www.fccihk.com/files/dpt_image/5_committees/Green%20Business/2013%2001%2031%20-%20Smart%20Cities%20-%20Hong%20Kong%20V5.pdf
Highlights	On key factor to achieve this goal is the collaboration between the local government, universities, businesses and other city stakeholders.		
Comments	The smart city process has been built with a series of consultations and workshops to produce and filter ideas.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	1 May 2015

	STAKEHOLDERS			
	Partner	Name	Hong Kong Government	
		Funder	☒ Yes ☐ No	
		Role	Management	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	University of Hong Kong	
		Funder	☐ Yes ☒ No	
		Role	Advisor	
		Type	☐	Government
			☐	Industry
			☐	Non-Governmental Organization Others: Academia
	Partner	Name	French Chamber	
		Funder	☐ Yes ☒ No	
		Role	Promotor	
		Type	☐	Government
			☐	Industry
			☒	Non-Governmental Organization
	Partner	Name	Dragages HongKong	
		Funder	☐ Yes ☒ No	
		Role	Developer	
		Type	☐	Government
			☒	Industry
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	China
	State/Province	n/a
	City	Hong Kong
	Region	Eastern Asia
	Date	2013

<table>
<tr><td rowspan="8">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">Hong Kong's population was 7.241.700 million people in 2014. The population density in 2013 was 6.650 people/km2. Hong Kong has an excellent ICT infrastructure supporting the delivery of secure e-services and the development of the local ICT industry. With the market liberalization, the infrastructure provides Internet access at an affordable price. The household broadband penetration rate is 85% and the mobile penetration rate is 231%. The average peak Internet connection speed is 63.6 Mbps and the average Internet connection speed is 10.9 Mbps. The air pollution in Hong Kong is 53%.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☐ Eco City
☐ Ubiquitous City
☒ Smart City</td></tr>
<tr><td>What is About Summary</td><td>Hong Kong has severe waste, water, energy and air quality problems. To tackle those problems they are exploring the options offered by smart city technologies to integrate and optimize the usage of key resources (water, waste, transport, buildings).</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovation aspect of the project is the way it is being built through an innovative work-method where jointly with multidisciplinary stakeholders that collaborate to achieve breakthrough results, together with a series of consultations and workshop that are being conducted to produce new ideas.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">The project has a big consortium of 13 member companies, which are involved in the definition of the smart city strategy and much more wish to participate actively in one of the following strategic axes:
o Solid Waste Management;
o Water Supply and Waste Water Management;
o Mobility;
o Building;
o City Platform for Government and Citizens.
This hat represents a good example of a collaborative innovation process that involves several entities such as government, universities, business and other NGOs.</td></tr>
<tr><td>Comments</td><td colspan="2"></td></tr>
</table>

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☐ Mobility		
		☒ Environment		○ Energy savings, up to 30%; ○ Reduction of water losses, up to 20%; ○ Reduce air pollution; ○ Long-term environmental sustainability.
		☐ Social Development		
		☐ Quality of Life		
	Benefits	○ Treatment of waste; ○ Reduce the energy and water consumption; ○ Improve the quality of air; ○ Enhanced efficiency; ○ Customized services; ○ Better quality of life; ○ Improving attractiveness for residents, citizens and visitors.		
	Values	○ Innovation and creativity; ○ Environmental culture; ○ Collaboration in building and decision process; ○ Environmental sustainability.		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	The project combines public governance (includes national, regional as well as local city officials), people ownership and business collaboration.
	Maturity	The maturity of the smart city project is high, because it tries to tackles all smart city domains and involves all stakeholders in the process.
	Challenges	○ Overloaded infrastructure; ○ Congestion; ○ Environmental targets; ○ Pollution; ○ Scarcity of resources; ○ Reduce costs; ○ Attract global investment, jobs and talent.
	Risks	○ Spread of infections caused by pollution; ○ Higher impact of natural impacts; ○ Increase urban migration; ○ Increasing disparities in wealth and knowledge.
	Tools	○ Hong Kong Smart City Model.
	Technologies	○ Internet of Things; ○ City-wide Wi-Fi; ○ Big data analytics; ○ Cloud computing.

C.3.20. Case Study 20 – Tianjin Eco-City, China

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID0020
INITIATIVE	**Tianjin Eco-City**
COUNTRY	China

INTRODUCTION
This document is the result of a survey, which aims at identifying best practices related to Smart Cities for Sustainable Development. Of interest are Smart City initiatives – at national, local or regional level, contributing to sustainable development. In order to obtain uniform descriptions of different initiatives, the survey relies on a conceptual framework comprising five questions applied to each practice: 1. Who developed the practice? The question determines the institution developing the practice as well as its partners. 2. Where the practice has been developed? The question determines the country, state/province, city or region where the practice has been developed as well as the time frame of its development. 3. What is the practice about? The question determines the aim of the practice and summarizes its main features and lessons learnt. 4. Why the practice is relevant? The question determines the impact of the practice in terms of its contribution to the different dimensions of smart cities - social, economic, environment, governance, mobility and quality of life. 5. How the practice is delivered? The question determines the mechanism used for delivering the practice, such as policy instruments, tools, technologies and others. This document is structured into the corresponding five sections – who, where, what, why and how; preceded by information: 1) About the practice – name and case; 2) About the survey – major sources used to carry out the survey with URLs and descriptions, the most representative highlights used to describe the practice and any auxiliary comments; and 3) About the surveyor – who carried out the survey and when.

PRACTICE	
Name	**Tianjin Eco-City**
Case	ID0020

SURVEY			
Sources	No	Description	Reference

	1	Tianjin Eco-City is an eco-city joint project between the Tianjin Eco-City Investment and Development Co., Ltd. (SSTEC) and the Chinese and Singapore governments. The goal is to build a new city of 350.000 dwellers with 110.000 houses by around 2020. The vision of the project is underpinned by three harmonies and three abilities. The harmonies address the social, economie, and environment. The abilities address affordability, replicability and scalability.	http://www.tianjinecocity.gov.sg/bg_intro.htm http://www.hitachi.com/csr/highlight/2011/act1102/ http://www.tianjineco-city.com/
Highlights	The China government intention was Tianjin becomes an Eco-City Model for all urban spaces in China because almost all cities in China are enveloped in smog and pollution. 7 years after the project was started, the city has only 20.000 citizens, but a new city arose from a degraded space.		
Comments	Tianjin - A city model for an environmental aware urban planning in China.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	2 May 2015

	STAKEHOLDERS			
WHO	Partner	Name	Tianjin Eco-City Investment and Development Co., Ltd. (SSTEC)	
		Funder	☐ Yes ☒ No	
		Role	Master developer	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Chinese Government	
		Funder	☒ Yes ☐ No	
		Role	Investor and planning	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name	Singapore Government	
		Funder	☒ Yes ☐ No	
		Role	Investor and planning	
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization

	LOCATION AND TIME	
WHERE	Country	China
	State/Province	n/a
	City	Tianjin
	Region	Eastern Asia
	Date	2007

<table>
<tr><td rowspan="7">WHAT</td><td colspan="3">AIM</td></tr>
<tr><td>City Background</td><td colspan="2">The new Eco-city site is located 40 km from Tianjin city centre and 150 km from Beijing city centre. It is located within the Tianjin Binhai New Area, one of the fastest growing regions in China. Tianjin Binhai New Area is in turn located in the Bohai Bay region (which covers Beijing, Tianjin and part of the Hebei Province), which has been identified as the next growth engine in China, after the Pearl River delta and the Yangtze River delta. The Eco-City is highly accessible from key cities and industrial districts in the region via major highways, railways, air routes, and shipping lines.
Tianjin Eco-city has a total land area of 30 km2. The Eco-city is planned for a population of 350.000 people. The forecast is to develop the Eco-city over 10-15 years. The start-up area is scheduled for completion by end-2013. Since 2007, the site has been contaminated with mercury, DDT, and wastewater.</td></tr>
<tr><td rowspan="2">Concept</td><td>Type</td><td>☐ Energy City
☐ Digital City
☐ Intelligent City
☐ Knowledge City
☒ Eco City
☐ Ubiquitous City
☐ Smart City</td></tr>
<tr><td>What is About Summary</td><td>The Sino-Singapore Tianjin Eco-City project is about deploying a sustainable city that full fits all environment requirements. The city should be able to create a vibrant economy where residents have a good quality of life and live in harmony with the environment. The city will be developed with cutting edge technologies and iconic buildings.</td></tr>
<tr><td>Innovation(s)</td><td colspan="2">The innovative aspects of this project are associated with its three abilities:
○ Practicable: the technologies adopted in the Eco-city must be affordable and commercially viable;
○ Replicable: the principles and models of the Eco-city could be applied to other cities in China and even in other countries;
○ Scalable: the principles and modes could be adapted for another project or development of a different scale.</td></tr>
<tr><td>Lessons Learnt</td><td colspan="2">Almost all cities in China have ecological problems to tackle that environmental challenge China is committed in building a reference urban model of a sustainable Eco-City that is ecologically friendly, socially harmonious and resource efficient.</td></tr>
<tr><td>Comments</td><td colspan="2"></td></tr>
</table>

WHY	Drivers	☐ Economic Development	Outcome:	
		☐ Governance		
		☐ Mobility		
		☒ Environment		○ Clean water (100% potable tap water, 50% non-traditional resource, 0% loss of natural wetland); ○ Clean environment (100% green building, >90% green trips by 2020, >60% overall recycling rate); ○ Clean energy (>20% renewable energy use, 100% coverage).
		☐ Social Development		
		☐ Quality of Life		
	Benefits	○ Ambient quality; ○ Quality of water; ○ Reduced carbon emissions; ○ Green buildings; ○ Green spaces; ○ Waste treatment; ○ Internet coverage; ○ Affordable public housing; ○ Renewable energy; ○ Build a R&D scientists and engineers workforce.		
	Values	○ Innovation; ○ Environmental culture; ○ Environmental sustainability; ○ Social harmony;		

HOW	Approach	☒ Top-Down (Government-Driven) ☐ Bottom-Up (Citizen-Driven)
	Governance	Not applicable
	Maturity	The maturity of the project is high, it includes the vision, master plan, Key Performance Indicators (KPI), Milestones and the main economic, social an environment drivers.
	Challenges	○ Achieve environmental targets; ○ Attract global investment, jobs and talent; ○ To be economically, socially and environmentally sustainable; ○ To be replicable; ○ To be practicable; ○ To be scalable.
	Risks	○ To become an empty city (ghost city); ○ Project management risks; ○ Project cost and financing; ○ Affordability and social inclusion; ○ Public versus public interests; ○ New city planning risks; ○ Integration of resources (transports, communication, governance, water and waste systems, etc.).
	Tools	○ Eco-City Model; ○ Master Plan; ○ Key Performance Indicators (KPIs)
	Technologies	○ Eco-technologies

C.3.21. Case Study 21 – Guimarães Green City, Portugal

Smart Cities for Sustainable Development – State of Practice Survey	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

CASE	ID021
INITIATIVE	Guimaraes European Green Capital
COUNTRY	Portugal

PRACTICE	
Name	City of Guimarães
Case	ID0021

SURVEY			
Sources	No	Description	URL
	1	Citizens have the right to contribute to the sustainability of their own communities. The provision of mechanisms for democratizing participation enables the population to be engaged in verifiable growth, sustainability and resilience practices. Guimarães proposes to pioneer this process by offering to transform itself into a living campus of sustainability citizenship and community development. Citizens' potential and willingness to engage in sustainable development strategies is well-known. Often local governance is not prepared to offer solutions to disclose such potential. Thus, Guimarães is willing to take the lead at the European level, by sharing its open intelligent governance vision, principles and experiences with its European fellow cities and town. European programmes such as Smart Cities and Communities provide ideal context for those experiences to be disseminated and therefore have a broader impact. The project objectives are twofold. Primarily, it focuses on establishing an integrated set of local governance instruments to achieve sustainable and resilient citizenship. Secondly, the project aims at sharing the city wide open urban governance living campus with other European local communities. The governance instruments include: 1) integration, 2) diversification, and 3) innovation as explained below. 1. *Integration* – Measures will be taken to integrate sustainability requirements with all the local urban management programmes, strategies and actions. Example initiatives for this vision include: the electrification of the public transports and commuting networks, the requalification of public lighting, the implementation of adaptive local taxes system such as "zero CO2 emission / zero tax" solution, bioelectricity generation, water and waste management, PV urban hubs, urban forest parks management and carbon neutral public procurement. Under the vision for integration, a reference Sustainable Energy Action Plan was shared with around 5,000 European municipalities; networks were formed; and innovation-driven local platforms were established.	http://www.cm-guimaraes.pt/

		2. *Diversification* – Diversified measures, oriented to specific economic sectors, population groups, and local agglomerations, are set to engage actors and population. Capacity building, incentives to eco-building, environmentally neutral investment attraction, energy educational programmes promotion, sustainability illiteracy eradication, stimulation of technological innovation absorption, fixation of social capital are among the planned measures. A distributed sustainability campus, operating over Guimarães territory, will host, consolidate and unify local interventions. This makes real Guimarães' visions of integrated city management and open innovative strategic development in order to be shared with local partners, regional stakeholders or European wide clusters. Verification, monitoring and urban data management mechanisms are maintained to allow the participating citizens and agents to assess the impact of their individual contributions. These instruments form an Intelligent Governance Platform to support and consolidate the project activities very much in line with the Smart Cities and Communities paradigm. Guimarães is prepared to offer itself as an open campus for urban innovation and smart development, as city scale laboratory where sustainable citizenship is transformed into verifiable sustainable and resilient development results environmental results. To be significant at global level, project achievements have to be widely propagated. The existing networking fora will be exploited to share acquired knowledge and to encourage fellow communities throughout Europe to unveil the potential of sustainable citizenship by adopting innovative sustainability oriented governance. Guimarães vision had its followers in Europe. Fellow cities required Guimarães leadership of European projects, initiatives, agendas and platforms namely under the scope of Smart Cities portfolio of initiatives and European Covenant of Mayors' scopes. 1000Years / 1000Smart network, in which new visions for vibrant futures of millennially resilient communities are spun from smart cities generated momentum.	http://www.cm-guimaraes.pt/
Highlights	The developed approach combines bottom-up, citizenship generated initiatives and new forms of city living, with to down smart development measures.		
Comments	Full compliance and integration with European strategies, namely ones related with cities of tomorrow, open innovation, leaving labs, and smart cities.		

SURVEYOR	
Who	Nuno Vasco Lopes (researcher)
	Mário Peixoto (editor)
When	13 June

HO	STAKEHOLDERS			
	Responsible Institution	Name		Câmara Municipal de Guimarães
		Funder		☒ Yes ☐ No
		Role		Governance animator
		Type	☒	Government
			☐	Industry
			☐	Non-Governmental Organization
	Partner	Name		IrRADIARE
		Funder		☐ Yes ☒ No
		Role		Concept coordinator
		Type	☐	Government
			☒	Company
			☐	Non-Governmental Organization

WHERE	LOCATION AND TIME	
	Country	Portugal
	State/Province	North of Portugal / Minho
	City	Guimarães
	Region	Região do Ave
	Date	2014

WHAT	City Background		
	Concept	Type	☒ Digital City ☒ Intelligent City ☒ Knowledge City ☒ Eco City ☐ Ubiquitous City ☒ Smart City
		What is About Summary	
	Innovation(s)	Being an historic city, patrimony of UNESCO, where Portuguese country, has born, the innovation resides in becoming a smart historic city.	
	Lessons Learnt	The major difficulty is to change the traditional mentality and local culture in relation to environment issues.	
	Comments	Guimarães' view attracted other European fellow cities to engage	

<table>
<tr><td rowspan="8">WHY</td><td rowspan="6">Drivers</td><td>☒ Economic Development</td><td rowspan="6">Outcome:</td><td>Outcome: Economic growth acceleration</td></tr>
<tr><td>☒ Governance</td><td>Attractiveness for levering investment, high growth business, knowledge emergence, creativeness and risk-taking and social innovation.</td></tr>
<tr><td>☒ Mobility</td><td>The lifeblood of new vibrant ways of living the urban environment and the city context.</td></tr>
<tr><td>☒ Environment</td><td>Better protected environment, urban biodiversity, natural resilience,</td></tr>
<tr><td>☒ Social Development</td><td>jobs creation, opportunities for all, inclusion, social development and community spirit and shared more vibrant ways of living the city.</td></tr>
<tr><td>☒ Quality of Life</td><td>better developed protective communities, healthy environment, opportunities for personal development, community vibrancy and creative social realization, economy and urban environment</td></tr>
<tr><td>Benefits</td><td colspan="3">Social development
Environmental responsibility
Economic progress
Shared open with partners and counter partners who may feel attracted by Guimarães vision.
Energy and waste management systems</td></tr>
<tr><td>Values</td><td colspan="3">Resilience
Sustainability
Inclusion
Transparency
Openness
Community</td></tr>
</table>

<table>
<tr><td rowspan="7">HOW</td><td>Approach</td><td>☒ Top-Down (Government-Driven)
☐ Bottom-Up (Citizen-Driven)</td></tr>
<tr><td>Governance</td><td>Governance model for autonomous strategic decision-making. Open data to provide city's data to citizens.</td></tr>
<tr><td>Maturity</td><td>Guimarães European profile and presence is continuously growing along last years. The mentioned initiatives are concurrently developed under a number of projects. The initiative has a governance model, a vision, a strategy and an implementation plan.</td></tr>
<tr><td>Challenges</td><td>Keeping the momentum</td></tr>
<tr><td>Risks</td><td>Economic contextual down turns</td></tr>
<tr><td>Tools</td><td>Data and Information Systems
Living lab</td></tr>
<tr><td>Technologies</td><td>Sensor Networks
Internet of Things
ICT Platforms
Network Integrated Communications
High-speed Communication Networks</td></tr>
</table>

C.4. Interview Protocol

Smart Cities for Sustainable Development Interview Protocol	UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

INTRODUCTION
This document describes the interview protocol used to learn from leading experts about their experiences in implementing Smart City initiatives. The interview aims at exploring six main issues related to Smart City planning and implementation: LOCAL CONTEXT – what were major factors of the local context facilitating the implementation of the initiative? CHANGE – what were major changes that were needed for implementing the initiative? CHALLENGES – what were major challenges faced for implementing the initiative? RISKS – what were major risks related to the initiative? GOVERNANCE – what type of governance model was adopted and how was it implemented? MEASUREMENT – how the initiative is assessed and measured with respect to the goals? The rest of this document is structured as follows: 1) INTERVIEW – who was interviewed, who interviewed, and when and where was the interview conducted; 2) PROTOCOL – describing the questions to be formulated during the interview and some hints for the replies; 3) CHALLENGES – a list of challenges that can be used to respond to the corresponding question; and 4) RISKS – a list of risks to Smart City projects.

INTERVIEW	
INTERVIEWEE	
INTERVIEWER	
TIME	
PLACE	

PROTOCOL	
LOCAL CONTEXT	
Q1	What were three major enablers or conditions of the local context that contributed for implementing the initiative? HINTS: strong political leadership, well-defined government agenda, pressure from citizens, needs to protect environmental resources, need to diversify the economy, leverage on existing human capital, need to solve a social problem, etc.
CHANGE	
Q2	What were three major changes, if any, that you had to make for implementing the initiative? HINTS: new laws, regulations, organizational structures, business processes, work flows, deployment of new technology, new competencies of human resources, new capacities of government agencies
CHALLENGES	
Q3	What were three major challenges faced for implementing the initiative and which were the mechanisms adopted to overcome them? HINTS: you can identify challenges faced by the initiative from the list of challenges included in the appendix or you can add new challenges
RISKS	
Q4	What were three major risks related to the initiative that required to be managed? HINTS: you can identify risks related to the initiative from the list of risks included in the appendix or you can add new risks
GOVERNANCE	
Q5	What type of collaborative/participatory governance model, if any, was developed for the initiative?
Q6	How was the model implemented in practice and what were the pros and cons of implementing such model?
Q7	How were private (economic) and public (environmental and social) interests balanced?

MEASUREMENT	
Q8	How the initiative is assessed and measured with respect to the achievement of the goals?
OTHER COMMENTS	
Q9	Is there any other important issue or lesson learnt from the initiative that you would like to share?

LIST OF CHALLENGES		
ID	TYPE	DESCRIPTION
CH1	Financial	Ensuring availability of financial resources
CH2	Financial	Attracting investors
CH3	Financial	Ensuring the construction of cost-effective buildings/facilities
CH4	Financial	Reducing costs
CH5	Technical	Ensuring the adoption of interoperability standards
CH6	Technical	Updating new releases of services
CH7	Technical	Having the appropriate technology at the right time
CH8	Social	Ensuring social cohesion
CH9	Social	Ensuring equity and fairness among citizens
CH10	Social	Ensuring territorial cohesion
CH11	Social	Avoiding technology polarization of citizens
CH12	Social	Ensuring the development of social and cultural values
CH13	Social	Ensuring social sustainability
CH14	Environmental	Ensuring environmental sustainability
CH15	Environmental	Reducing carbon emissions
CH16	Environmental	Ensuring efficient use of natural resources
CH17	Environmental	Achieving sustainable development only through green practices
CH18	Environmental	Reducing air pollution
CH19	Environmental	Reducing oil and gas dependency
CH20	Environmental	Reducing traffic congestion
CH21	Environmental	Addressing the scarcity of natural resources
CH22	Governance	Providing enough incentives for the private sector
CH23	Governance	Ensuring collaboration between partners
CH24	Governance	Engaging private sector in testing solutions
CH25	Governance	Adopting decision/proposals made by citizens
CH26	Governance	Defining the proper role for private sector actors – where, when, how
CH27	Governance	Attracting talents
CH28	Governance	Enabling distributed implementation with central coordination
CH29	Governance	Establishing a governance committee with broad representation of government levels and societal sectors
CH30	Quality	Ensuring 24x7 service availability
CH31	Quality	Ensuring customers' satisfaction
CH32	Quality	Maintaining data and data-sets up to date
CH33	Quality	Ensuring the construction of comfortable buildings/facilities
CH34	Implementation	Contextualizing the project/solution to the local conditions
CH35	Implementation	Ensuring integration of city infrastructure to an integrated ICT platform
CH36	Implementation	Ensuring the availability of the service to different communities in the city
CH37	Implementation	Overcoming bureaucratic procedures in government agencies
CH38	Implementation	Producing a scalable solution
CH39	Human Capital	Attracting qualified IT professionals and relevant IT players

CH40	Human Capital	Having qualified human resources for service delivery
CH41	Human Capital	Leveraging human capital
CH42	Economic	Improving competitiveness against international markets
CH43	Economic	Controlling wild capitalism
CH44	Economic	Achieving sustainable development only through green practices
CH45	Economic	Ensuring economic sustainability and growth
CH46	Economic	Stimulating economic development

LIST OF RISKS		
ID	TYPE	DESCRIPTION
RK1	Social-Divide	Deepening social polarization and gentrification
RK2	Social-Divide	Strengthening digital divide
RK3	Social-Divide	Increasing disparities with respect to health services and access to knowledge
RK4	Social-Exclusion	Rising citizens' feeling of exclusion due to restrict access to connectivity and services
RK5	Social-Exclusion	Rising citizens' feeling of exclusion due to controlled access to exclusive places
RK6	Social-Exclusion	Social exclusion of local citizens due to efforts for attracting qualified foreigners
RK7	Social-Exclusion	Neglecting citizens' opinions due to political interests
RK8	Social-Exclusion	Not addressing special needs of service recipients
RK9	Social-Adoption	Delivering low take-up of services due to expensive fees
RK10	Social-Adoption	Facing low adaptation and flexibility capacity for adopting new solutions
RK11	Social-Adoption	Not being able to attract inhabitants for a new developed city
RK12	Social-Impact	Disregarding the social and ethical impact of ICT
RK13	Social-Impact	Rising negative experiences faced by citizens and visitors due to high surveillance
RK14	Social-Impact	Developing a society driven by individuals instead of communities' values due to the lack of common history and culture of dwellers
RK15	Social-Concerns	Rising citizens' concerns on privacy and security due to pervasive deployment of ICT
RK16	Social-Concerns	Promoting economic development disregarding social concerns
RK17	Social-Concerns	Facing cultural issues (e.g. lack of transparency of government authorities, partners)
RK18	Financial	Lacking financial resources to afford the costs of initiatives
RK19	Financial	Not being able to attract investors
RK20	Financial	Not being able to efficiently collect service fees
RK21	Technical	Be driven by a very technology-centered vision
RK22	Technical	Facing cyber-attacks
RK23	Technical	Limited capacity for satisfying service transport demand
RK24	Technical	Lack of methodology to support urban related research
RK25	Technical	Generalizing results without proper contextualization
RK26	Technical	Lack of alignment among project components
RK27	Technical	Developing decoupled city infrastructure components
RK28	Environmental	Having negative environmental impact of city development
RK29	Environmental	Not achieving the reduction of carbon footprint to comply with the Kyoto protocol
RK30	Environmental	Promoting economic development disregarding environment concerns
RK31	Economic	Promoting economic development only based on energy resources
RK32	Economic	Developing an economy highly influenced by external factors
RK33	Economic	Promoting economic development focused only on ICT-knowledge
RK34	Economic	Developing an economy highly dependent on ICT