Public Administration and Information Technology 22

Leonidas G. Anthopoulos

Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?

Springer

Public Administration and Information Technology

Volume 22

Series editor

Christopher G. Reddick, San Antonio, TX, USA

More information about this series at http://www.springer.com/series/10796

Leonidas G. Anthopoulos

Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?

Springer

Leonidas G. Anthopoulos
Project Management Department
Technological Educational Institute (TEI)
Larissa
Greece

ISSN 2512-1812 ISSN 2512-1839 (electronic)
Public Administration and Information Technology
ISBN 978-3-319-57014-3 ISBN 978-3-319-57015-0 (eBook)
DOI 10.1007/978-3-319-57015-0

Library of Congress Control Number: 2017937462

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Writing a book is really a hard and demanding process, which many times questions your patience and courage. Thankfully, I had my wife and kids supporting me during this discipline, who I missed for long and I would like to thank for their understanding and encouragement.

Foreword

This book gives an overview of smart cities and related activities. The book first reviews smart technologies, smart services and then visits a number of smart cities in practice, and then discusses how to govern smart cities to create a smart government. The book helps readers to understand smart cities and their future from various aspects.

From the 1990s to the 2000s, digital cities, the early stage of smart cities, had been developed and had become operational in Europe and Asia. At first glance, it seems natural to regard today's smart cities as the successor of digital cities. It is also natural to think that their differences are due to the technologies they use, i.e., digital cities are characterized by activities based on web services, while current smart cities demonstrate sensory services. This interpretation is not wrong but not so persuasive, because some of digital cities have been developed to connect virtual and real cities. For example, we started a digital city Kyoto in 1998 to make it real by establishing a strong connection to the physical Kyoto: The digital city complemented the corresponding physical city, and provided an information center for everyday life for actual urban communities. We thought "digital" and "physical" make things "real."

Let us submit two keywords "digital city" and "smart city" to Google Trends on trial. We learn that the smart city movement evolved ten years after the termination of digital city activities. In the meantime, global optimization of resource usage was attracting increasing attention around the world. Though there certainly are technological advances from digital to smart cities, it is more meaningful to see "digital city," the early stage of smart cities, as the exploration of cyber space, while the current "smart city" is the exploitation of physical space. The definitions and examples of smart cities are well investigated and summarized in this book that can trigger broad discussions on future cities.

One evolution of future cities, we may say, is the socialization of commerce. A typical example is Industrie 4.0 in Germany. The initiative aims at networking a large number of manufacturing companies to create a nation-wide supply chain. Large-scale factories in developing countries for mass production are no longer necessary. Instead, a network of many companies for mass customization will appear regionally. Another evolution is the commercialization of society. Networking of unused resources in society can reveal profitable resources. A typical example is called the sharing economy. Since most cars in large cities are idled in parking lots, it is reasonable to share them to reduce environmental burden. We can expect the convergence of the two evolutions in the future, i.e., for-profit and non-profit activities will be connected seamlessly to sustain our society.

This book provides a good step to explore such a future direction of cities and human societies.

Kyoto, Japan
March 2017

Prof. Toru Ishida[1]
Department of Social Informatics
Kyoto University

[1]http://www.ai.soc.i.kyoto-u.ac.jp/∼ishida.

Acknowledgements

This research has been partly supported by the project EADIC (http://eadic.teithessaly.gr), which was funded by European Union (European Social Fund—ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF)—Research Funding Program: ARCHIMEDES III. Investing in knowledge society through the European Social Fund. Moreover, pieces of this work were supported by the project InSmart (Integrative Smart City Planning) (http://www.insmartenergy.com/), which has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 314164.

Special thanks to all contributors for their input in this study: Director of Tampere city's development unit; Head of Telecommunications of Services Industriels de Genève (LSIG); Gale International; project manager of Smart City Wien; Director of Middleware Engineering and Rapid App Development of the World Bank; NYC DoITT's Deputy and the Associate Commissioners; OGC Senior Administrative Officer, The Government of the Hong Kong Special Administrative Region; Strategic Planning Office (SPO) of the Municipality of Melbourne; and the Smart Dubai Office.

Finally, I would like to thank Prof. Toru Ishida, Kyoto University, Japan, for his Foreword, which opens future perspectives of the topics discussed in this book and for his contributed interview. His work and his case of the Digital City Kyoto inspired me to engage with the smart city context.

Papers that have been conceptualized by this book, contributed to its context and being referenced wherever they are utilized:

1. Anthopoulos, L. (2017). Smart Utopia VS Smart Reality: Learning by Experience from 10 Smart City Cases. *Cities*, 63, pp. 128–148.
2. Anthopoulos, L., Janssen, M. and Weerakkody, V. (2016) A Unified Smart City Model (USCM) for smart city Conceptualization and Benchmarking. *International Journal of e-Government Research (IJEGR)*, 12(2), pp. 76–92.

3. Anthopoulos, L., Fitsilis, P. and Ziozias, C. (2016). What is the Source of Smart City Value? A Business Model Analysis. *International Journal of e-Government Research (IJEGR)*, 12(2), pp. 55–75.
4. Anthopoulos, L. and Reddick, Ch. (2015). Understanding electronic government research and smart city. Information Polity, vol. 21, no. 1, pp. 99–117. DOI: 10.3233/IP-150371
5. Anthopoulos, L. and Fitsilis, P. (2014). Smart Cities and their Roles in City Competition: A Classification. *International Journal of Electronic Government Research (IJEGR)*, 10 (1), pp. 67–81.
6. Anthopoulos, L., Ipsilantis, P., Kazantzi, V. (2014). The Project Management Perspective for a Digital City. *International Journal of Information Technology Project Management (IJITPM)*, 5(1), IGI Global.
7. Anthopoulos, L. and Giannakidis, G. (2016). Task-Based Process Modeling for Policy Making in Smart Cities. In the *Proceedings of the 8th ITU Kaleidoscope Academic Conference*, Bangkok, Thailand, Nov. 14–16, 2016.
8. Anthopoulos, L., Giannakidis, G. and Sakkas, S. (2016). Realizing, Modeling and Evaluating City's Energy Efficiency: the case of InSmart in the city of Trikala, Greece. In the *Proceedings of the 3rd International Conference for E-Democacy and Open Government, Asia 2016 (CEDEM ASIA 2016)*, Daegu, S. Korea, Dec. 7–9, 2016.
9. Anthopoulos, L. (2015). Defining Smart City Architecture for Sustainability. In the *Proceedings of the 14th IFIP Electronic Government (EGOV) and 7th Electronic Participation (ePart) Conference 2015, 30th August - 3rd September 2015, Thessaloniki, Greece*.

Contents

About the Author

Leonidas G. Anthopoulos is Associate Professor at the Business School of the TEI of Thessaly and Director of the Postgraduate Program in Project and Programme Management. Dr. Anthopoulos has extensive IT research, planning and Management experience with regard to the development and deployment of complex IT projects. He is a member of various committees, worth mentioning the ITU Smart City Focus Group, Associate Editor of the IJPADA journal (IGI-GROUP) and editor of book collections. Some of his articles can be found on Government Information Quarterly, Information Polity, Transforming Government, etc. His research interests concern, among others, Smart City, e-Government, Enterprise Architecture, Strategic Management, etc.

Chapter 1
Introduction

Smart cities have emerged radically since their initial appearance in literature in 1997 and they have attracted a significant scientific and industrial attention since then. The primary smart city exemplars were able to visualize local information—like a portal from local sources—or even to simulate the city's landscape—like an online map. These initial attempts were followed by knowledge bases and networks of people, where common knowledge was shared among the participants and they mainly concerned local issues (e.g., employment for post-industrial areas).

All these exemplars were based on the Internet and no extra facility was required, when cities started exploring cutting-edge infrastructure to upgrade local information performance. In this respect, broadband and later ultra-fast networks—wired and wireless—started being deployed in the city and the urban space enhanced its ability to deliver several types of smart services. Moreover, this infrastructure enabled cities to deal with several local issues—e.g., environmental downgrading from human facilities, transportation, aging etc., like waste management, intelligent transportation, and tele-care service provision accordingly etc. This urban upgrade with the use of technology started appearing in late 1990s and early 2000s and it was a critical milestone for the industrial engagement, which saw extensive opportunities to grow and develop several products that range from construction (e.g., sustainable buildings); to electronics (e.g., sensors for measuring internal and environmental performance, smart lighting etc.); to engineering (e.g., transportation); to software engineering (e.g., smart service deployment); and even to new entrepreneurship (e.g., in data and green economy).

This event was not accidental, since urbanization had started becoming a reality and international reports show a significant rise of cities by 2050, a shift that changes dramatically the role of city and of local government: a city has to host an extensive community (like megacities do today); and the government has to serve this community with a decreasing amount of resources and to deal with significant challenges (e.g., poverty, climate change and city competition etc.).

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_1

Such a potential demands a close collaboration between local governments and the industry, while the role of the triple helix (government, university and the industry) appears to be important. In this respect, several scholars and practitioners suggest alternatives for such a collaboration and smart city exemplars chose among them (e.g., Vienna has a strong collaboration with local stakeholders; New Songdo was the outcome of a project coalition; Masdar and other smart districts are the product of a Public-Private-Partnership (PPP) etc.). However, the same partnership rises criticism with regard to the open innovation character that the smart city used to have, as well as whether the smart city is really a requirement for governments or it is the outcome of marketing that obliges this collaboration.

Regardless the justification of this criticism, smart city is a fact and more and more cities either self-claim to be smart or undertake efforts to enter this era, and a significant number of city coalitions and organizations have been formed to handle this interest. Additionally, the size of the smart city industry increases steadily and it is estimated to exceed the amount of U.S. $1 trillion by 2025, which justifies the private sector's interest to develop new products and gain a share of this market. On the other hand, almost all standardization bodies struggle to develop standards to normalize and homogenize the developed solutions.

This reality comes in contrast to the ambiguous meaning of the terminology that deals with smart city (e.g., the smart city itself, smart government and smart governance etc.) and to the real concept and purpose of smart city (e.g., does it concern a today or a tomorrow city with futuristic features—like flying cars?). Additionally, the role of government in smart city development is still questioned, since its "marriage" with the private sector might alter the vision or diverge the mission of government to deal with the local challenges and instead to prioritize according to market's willing (technology push).

In this regard, this book has multiple objectives. First, the aim of this book is to clarify the smart city context and the role of government in smart city. This book comes from the observation that the terms smart city and smart governance are interconnected and they appear together but it is not clear how and why. Second, this book aims to become a guide for governments, researchers and practitioners to conceptualize and understand what the smart city is – according to both literature and practice –, what the components that synthesize a smart city are and what technological artefacts can be used to serve the smart city mission. Third, it aims to provide the readers with tools that can help them conceptualize, measure the potential, manage the development and evaluate the outcome of a smart city project. Fourth, it aims to serve as a didactic material for students that enter the smart city domain and in this respect, each chapter has specific learning outcomes and a pool of questions to support learning. As such, several outcomes from ongoing studies, an extensive scientific material (articles, books and reports), inputs from experts, personal experiences and city examples are utilized to serve the above quadruple mission.

After reading this book, the reader will succeed in gaining answers for the following questions:

1. *What is a smart city? Does it concern urban innovation or something more complicated?*
2. *What is the smart city in practice? What technological artefacts are synthesized and in which manner they collaborate in order to succeed in the owner's mission?*
3. *How is the smart city market structured and does it concern an industrial trick that leads government towards its development?*
4. *How the smart city—and its development—are governed and what is the role of government in a smart city?*
5. *What is the smart government and how is it related with the smart city?*

The development of this book focused on the smart city owner perspective (the one who develops and owns the smart city outcome) and it was based on a multi-methods approach, which combines literature reviews and reports' and standards' analysis; narrative walks and tests in cities; interviews with smart city representatives; panels of experts; questionnaires etc. Moreover, several articles were published during the development of this book that are mentioned in acknowledgements, since each chapter generated important research questions that had to be answered. Finally, two research projects contributed partially the development of this book, which are also mentioned in the acknowledgements.

This book contains five (5) more chapters. The following Chap. 2 explores the smart city theory (terminology and context), it defines several city coalitions and organizations, it classifies cities according to their approach and presents an architecture framework with several alternative views to support smart city understanding. Then, Chap. 3 explores the smart city practice in terms of applied technology, services, standards and exemplars. Chapter 4 analyzes the business terms of a smart city, via the presentation of the alternative types of business that structure the smart city market, while it determines the underlying smart city value and it compares corresponding business models. Finally, it questions the potential "smart city hoax" and differentiates city branding from marketing. Then, Chap. 5 utilizes the project and the innovation management perspectives to demonstrate how a smart city can be developed from scratch. It shows how to measure the existing potential of a city that can be compared with the available technological and smart service choices and define the development roadmap for the smart city owner. Finally, Chap. 6 differentiates smart city from smart government. It provides the term with definition and a unified conceptual framework, which clarifies the context and the potential of smart government, together with its interrelation with the smart city.

Chapter 2
The Rise of the Smart City

After reading this chapter, the following questions will be able to be answered:

– *How can the smart city be defined and conceptualized?*
– *What are the challenges for smart cities?*
– *How can city and smart city be classified?*
– *What is the roadmap for smart city evolution according to historical evidence from literature findings?*
– *What is the smart city architecture from a system point of view?*

2.1 Defining the Terms

There is no common consensus about what "*smart*" really means in the context of the information and communications technology (ICT) (Cellary 2013). Although this term has become fashionable, it is also broadly used as a synonym of almost anything considered to be modern and intelligent. *Smart*, in purely definitional terms, has many synonyms, including percipient, astute, shrewd, and quick (Gil-Garcia et al. 2014). Moreover, *smart* is synonymous to efficient, when it is linked to devices (Meijer and Bolivar 2016). The following concise vision of smartness can be considered to be quite broad: *A servant surrounded by servants, which may be a configuration of both humans and devices, from both public and private sectors.* While the word "servant" evokes images from aristocracy to slavery in the evolving smart ecosystems, a person or system will be surrounded by or embedded within "servant systems", which are the smart systems. Moreover, the term smart refers to *ideas and people that provide clever insights* but it has been adopted more recently in city planning through the cliché *smart growth* (Batty et al. 2012). Growth can be seen as city sprawl, population increase or local economic upgrade, while smart growth implies the achievement of greater city efficiency

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_2

through coordinating the forces that lead to growth: transportation, land speculation, conservation, and economic development (Batty et al. 2012).

Similarly, it is not easy to locate a common definition for the term city, while most people can conceptualize it according to individual experiences. A city is considered as an urban area, which according the United Nations (2005) typically begins with a population density of 1500 people per square mile but it varies across countries. Cities range according to their agglomeration from *localities* or *villages* (e.g., Greenland and Iceland) of 200–1000 inhabitants; to *communities* (or communes) of 1000–2500 people (e.g., Africa), to *towns* or *places* (e.g., Canada) or *cantons* with more than 400 (e.g., Albania) and less than 10,000 inhabitants (e.g., Greece); to *cities* with a population over 10,000 and 1.5 million inhabitants; and *megacities* with a population that exceeds 1.5 million people. Some cities are also called *global* or *international* due to their impact that attracts inhabitants beyond the country or even from all over the world. Small and medium-sized cities compete for resources against larger and better-equipped ones, while they all have peers (e.g., cities with similar characteristics) (Angelidou 2014). Another indicative definition says that "*city is an urban community falling under a specific administrative boundary*" (ISO 2014a, b), which shows that a city needs some model of governance. Community *is a group of people with an arrangement of responsibilities, activities and relationships*" (ISO 2016). Moreover, "*a city is a system of systems with a unique history and set in a specific environmental and societal context. In order for it to flourish, all the key city actors need to work together, utilizing all of their resources, to overcome the challenges and grasp the opportunities that the city faces*" (ISO 2014b).

Beyond their size and impact, cities can be classified according to their urban development stage to *new* and *existing* (Angelidou 2014). Most well-known cities are existing ones, but it is important to locate some new constructions, which are built to serve particular housing or economic or strategic needs: Tianjin (China), Masdar City (Abu Dhabi-UAE), PlanIT Valley (Portugal), Skolkovo Innovation Center (Russia), Cyberport Hong Kong (China), Songdo International Business District (South Korea), Cyberjaya (Malaysia) and Aspern (Vienna) are all cities from scratch or more likely to be new districts-parts of existing cities.

Cities are conceptualized as complex adaptive systems, which are comprised of components that belong either to *physical* or to *social* spheres (Desouza and Flanery 2013): *physical components* concern physical resources (i.e. the ingredients) and processes (i.e. tools to handle and distribute the ingredients) within a city's boundaries or that the city interacts with. *Social components* represent the human elements that reside within a city permanently or those that flow into, and/or interact with a city (people, institutions and activities). According to this approach, a city can be conceived as a mega-platform that brings these components to bear in an organized fashion.

The above components are also called *hard* and *soft* facilities respectively (Angelidou 2014; Neirotti et al. 2014): hard concern—except from the natural environment—all types of tangible facilities (e.g., buildings, streets, networks, bridges etc.), while soft concern intangible resources (e.g., people, organizations, knowledge, wealth etc.).

2.2 What Is *Smart City*?

It would be normal for someone to consider that smart city comes up from the combination of the above definitions: *an urban space that is surrounded by or is embedded with "smart systems" or a city with ideas and people that provide clever insights*. Smart systems should not be limited to ICT-based ones, but intelligence can refer even to creative design or new organizations etc. In this regard, the "smartness" of a city *describes its ability to bring together all its resources, to effectively and seamlessly achieve the goals and fulfil the purposes it has set itself* (ISO 2014b). However, if someone seeks for a clear definition for smart city, he will fail to locate one and instead, he will retrieve many alternatives, which generate an ambiguous meaning.

After its initial appearance in late 1990s, smart city definition ranges (Anthopoulos and Fitsilis 2014; Albino and Dangelico 2015; Nam and Pardo 2011; Chourabi et al. 2012; Gil-Garcia et al. 2014, 2016; Meijer and Bolivar 2016) from *metropolitan-wide information and communications technology (ICT)-based environments*; to *various ICT adjectives that describe a city* (Churabi et al. 2012); to *smart energy consumption, transportation and other hard asset management* (Neirotti et al. 2014); to *the "smartness footprint" of a city, which is measured with capacity indexes* (people, economy, living, environment, mobility and governance) (Giffinger et al. 2007); to *large-scale living labs for innovation testing* (Komninos 2002); to *the ability of a city to attract human capital and to mobilize this human capital in collaborations between the various (organized and individual) actors through the use of ICT* (Meijer and Bolivar 2016); to *the political jurisdiction (e.g., a city, a town, a nation) where a smart government applies emerging technologies and innovation* (Gil-Garcia et al. 2014, 2015); to *cities that undertake actions towards innovation in management, technology, and policy, all of which entail risks and opportunities* (Gil-Garcia et al. 2016); and to *innovative solutions—not limited to but mainly based on the ICT—that improve urban everyday life and enhance local sustainability in terms of people, governance, economy, mobility, environment and living* (Anthopoulos and Reddick 2015); or even recently, to the differentiation of the terms digital and smart cities: *digital cities exploit the cyberspace while the smart cities the physical space* (Ishida 2017). Moreover, Cocchia (2014) summarizes various definitions and discovers shared features characterizing smart cities, *which concern the role of innovation and technology; environmental requirements; and social development*.

Beyond the above, the European Commission programs FP7-ICT and CIP ICT-PSP approaches smart city as a "*user-driven open innovation environment*" (Schaffers et al. 2011), where city is seen as a platform that enhances citizen engagement and their willing to "co-create". "Openness" is being conceptualized in terms to apply various forms of relationships between people, services, infrastructure and technology (Lee et al. 2014). Open public services facilitate the coordination of people's participatory "living-playing-working" activities, while open-service oriented business models work according to open industry standards (in terms of infrastructure and technology) (Lee et al. 2014). In this respect, open innovation systems promote high quality social interactions (e.g., within communities), which enhance citizen engagement and participatory decision making.

Finally, it is important to mention how standardization bodies—at least the international ones—define the smart city: the International Telecommunications Union (ITU) (2014a, b) emphasizes on ICT and considers a *smart sustainable city as an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects*. Similarly, the International Standards Organization (ISO) (2014b) recognizes smart city as *a new concept and a new model, which applies the new generation of information technologies, such as the internet of things, cloud computing, big data and space/geographical information integration, to facilitate the planning, construction, management and smart services of cities*. Moreover, it defines smart city objective to pursue: *convenience of the public services; delicacy of city management; livability of living environment; smartness of infrastructures; long-term effectiveness of network security*. Furthermore, the British Standards (BSI 2014) concerns the smart city as *the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens*.

The author summarizes the above definitions to provide a new and quite "umbrella" definition to smart city: *the utilization of ICT and innovation by cities (new, existing or districts), as a means to sustain in economic, social and environmental terms and to address several challenges dealing with six (6) dimensions (people, economy, governance, mobility, environment and living)*. Depending on this ICT and innovation performance, as well as on the local priorities, each city performs differently and appears with alternative smart city forms.

Some of the smart city challenges have been already identified: *providing an economic base; building efficient urban infrastructure; improving the quality of life and place; ensuring social integration; conserving natural environmental qualities, and; guaranteeing good governance* (Yigitcanlar and Lee 2014). Moreover, these definitions demonstrate that scholars conceptualize smart city with alternative approaches. In this respect, Anthopoulos et al. (2016) performed a comparative analysis on existing smart city conceptual models (Table 2.1).

These models synthesize a smart city ecosystem, which consists of eight (8) components (Fig. 2.1) that establish a cyber-physical integration and—with the incorporation of standardization perspectives—concern:

1. **Smart infrastructure**: city facilities (e.g., water and energy networks, streets, buildings etc.) with embedded smart technology (e.g., sensors, smart grids etc.).
2. **Smart Transportation** (or smart mobility): transportation networks with enhanced embedded real time monitoring and control systems.

Table 2.1 Smart city conceptual models (Anthopoulos et al. 2016)

	Model	Description
Architecture		
Anthopoulos (2015)	Smart city dimensions	Resource, transportation, urban infrastructure, living, government, economy, coherency
Giffinger et al. (2007)	Smart city components	Smart economy, smart governance, smart people, smart mobility, smart living, smart environment
Glebova et al. (2014)	Smart city conceptual elements	Intellectual transport system, public security, energy consumption management and control, environmental protection and ICT
Hancke et al. (2013)	Sensor areas in smart city	Smart infrastructure, smart surveillance, smart electricity and water distribution, smart buildings, smart healthcare, smart services and smart transportation
Hollands (2008)	Smart city model	Instrumented (based on data collection) Interconnected (enable data flow) Smart (utilize data to improve urban living)
IBM Söderström et al. (2014)	Nine pillar models smarter city equation	Planning and management services Infrastructure services Human services Instrumentation (*the transformation of urban phenomena into data*) + Interconnection (*of data*) + Intelligence (*brought by software*)
Naphade et al. (2011)	Smart city model	Government services, transportation, energy and water, healthcare, education, public safety and other core ICT systems
Neirotti et al. (2014)	Smart city domains	Natural resources and energy, transport and mobility, buildings, living, government, economy and people
Yovanof and Hazapis (2009)	Digital city architectural framework for smart service provision	Infrastructure (communications); mobilized services (capability to mobilize data, applications and users); policy (legal framework to foster innovation)
Zygiaris (2012)	Smart city reference model	Multi-tier smart city model with several components and entities

(continued)

Table 2.1 (continued)

	Model	Description
Governance		
Albino and Dangelico (2015)	Smart city dimensions	– City's networked infrastructure that enables political efficiency and social and cultural development – Emphasis on business-led urban development and creative activities for the promotion of urban growth – Social inclusion of various urban residents and social capital in urban development – The natural environment as a strategic component for the future
Baron (2012)	Three level-model for city intelligence for resilience conceptualization	First level of city smartness: Led by example Second level of city smartness: govern the private urban actors Third level of city smartness: integrated approach (hi/medium/no resilience)
ISO (2014a, b)	A table of city characteristics where smartness is applied	Environmental context City history and characteristics Societal context City governance City subsystems (actors, activities, facilities and buildings, hard infrastructure, soft infrastructure, technical systems, city functions, scale)
ITU (2014a, b)	Attributes and core themes	Attributes: sustainability; quality of life; urban aspects; intelligence or smartness Core themes: society; economy; environment; governance
Lee et al. (2014)	Framework for smart city analysis	Urban Openness, service innovation, partnerships formation, urban proactiveness, smart city infrastructure integration, smart city governance
Leydesdorff and Deakin (2011)	Triple-Helix model of smart cities	Networks of universities, industry and government
Liu et al. (2014)	Smart city value chain (SCVC) model	Primary activities: smart inbound logistics; smart operations; smart outbound logistics; smart marketing; smart services Supportive activities: smart government; smart infrastructure; smart procurement; smart technology

(continued)

Table 2.1 (continued)

	Model	Description
Lombardi et al. (2012)	Triple helix model for smart city analysis and performance measurement	A table with rows: university, government, civil society, industry and columns: smart governance, smart economy, smart people, living, environment
United Nations Habitat (2014)	Dimensions of city prosperity	Productivity and the prosperity of cities Urban infrastructure: Bedrock of prosperity Quality of life and urban prosperity Equity and the prosperity of cities, environmental sustainability and the prosperity of cities
Planning and management		
Anthopoulos and Fitsilis (2013)	Technology roadmapping for smart city development	Patterns for smart city technological evolution
Lee et al. (2013)	Technology Roadmapping for smart city development	Interconnections between services and devices, and between devices and technologies
Data and knowledge		
Batty et al. (2012)	Structure of futurICTs smart city programme	Data analysis and modelling: mobility and transport behavior; urban land use transport; urban market transactions; urban supply chains Infrastructure: sensing and networks, new social media; integrated databases Management: decision support and participation; city governance
Bellini et al. (2014)	Knowledge model for smart city data (KM4City ontology)	Administration; street-guide; point-of interest; local public transport; Sensors; temporal; and metadata
Edvinsson (2006)	City as a knowledge tool model	Knowledge key driver definition and interrelation discovery (ICT and multimedia; university; society and entrepreneurship; knowledge cafes/cathedrals; diversity; strange attractors)
Facilities		
Calvillo et al. (2016)	Smart city energy interventions and energy system design model	Energy interventions areas: Generation, storage, infrastructure, facilities and transport Energy system design model: (i) System input (resources, costs, geolocation, energy prices, regulation, demand) (ii) System output (capacity, total production, costs, environmental benefits, viability)

(continued)

Table 2.1 (continued)

	Model	Description
Services		
Fan et al. (2016)	Smart health organization model	Multi-tier architecture for smart health service production in smart city
People		
Shapiro (2006)	Neoclassical city growth model	Employment growth sources: Productivity, quality of life
Thite (2011)	Urban factors for human capital attractiveness	*Magnets* (a healthy and well-educated workforce, clean environment, vibrant business climate, and a solid social and cultural infrastructure) and *glue* (city infrastructure, flexible regulation system)
Environment		
Shwayri (2013)	U-eco-city model	City as a range of ubiquitous services (including u-health, u-education, u-transport and u-government)
Tsolakis and Anthopoulos (2015)	Eco-city System Dynamics Model	A system of 5 interconnected components/subsystems: (i) population, (ii) housing, (iii) business, (iv) energy and (v) environmental pollution

3. **Smart Environment**: innovation and ICT incorporation for natural resource protection and management (waste management systems, emission control, recycling, sensors for pollution monitoring etc.).
4. **Smart Services**: utilization of technology and ICT for health, education, tourism, safety, response control (surveillance) etc. service provision across the entire city.
5. **Smart Governance**: smart government establishment in the urban space, accompanied by technology for service delivery, participation and engagement.
6. **Smart People**: measures that enhance people creativity and open innovation.
7. **Smart Living**: innovation for enhancing quality of life and livability in the urban space.
8. **Smart Economy**: technology and innovation for strengthening business development, employment and urban growth.

These components are interconnected and require data collection and ICT infrastructure, to be embedded within city hard infrastructure to deliver smart services to city actors, while governance is necessary in order for the subsystems to be orchestrated and succeed in smart city mission (Fig. 2.2).

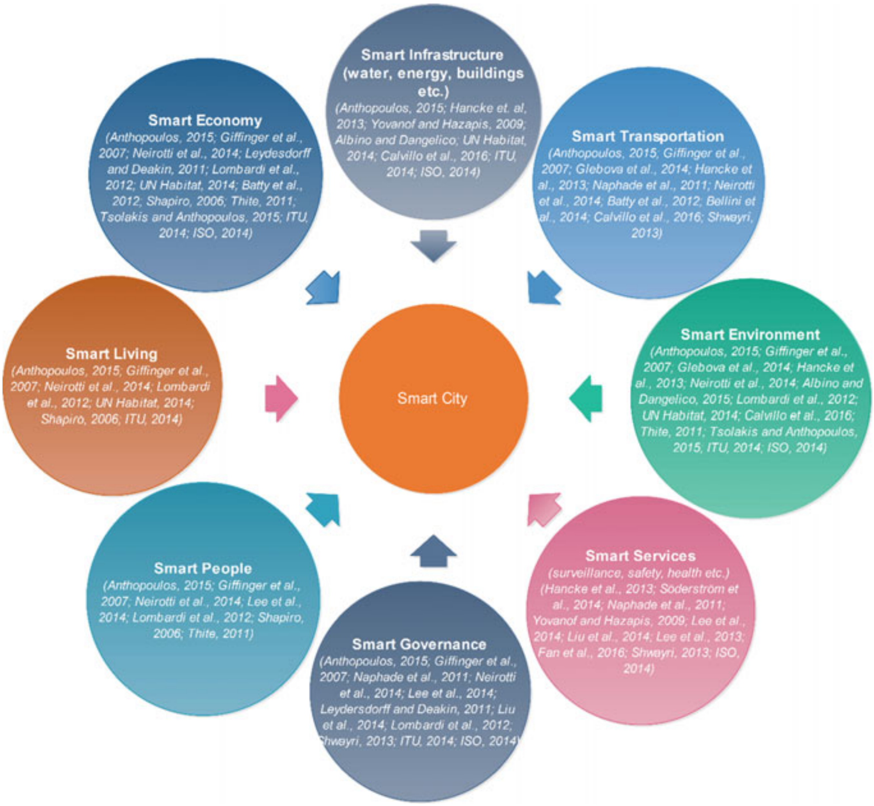


Fig. 2.1 Smart city components

2.3 The Smart City Evolution

The smart city concept started appearing in time with different terms and perspectives as a means to define urban technological evolution. More specifically, smart city was not the initial term that was used by scholars. Instead, scholars in late 1990s started discussing about city and ICT from different perspectives and with the use of different terms, in their attempts to describe ICT project initiation within the urban space or the utilization of the ICT to treat local needs (Fig. 2.3).

First evidence regarding smart city appears in literature in 1997 (Graham and Aurigi 1997), where it is claimed that over 2000 virtual cities and urban web pages existed in 1997, which introduced the term ***web*** or ***virtual city*** in an attempt to describe local ICT network initiatives, which enabled the development of local cyber-based (virtual) communities (decentralized, interactive, one-to-one and one-to-many media networks). Virtual cities were based on the World Wide Web (WWW) and they operated as electronic analogies for the real, material, urban areas that host them. The promise of virtual cities was to develop new interactive

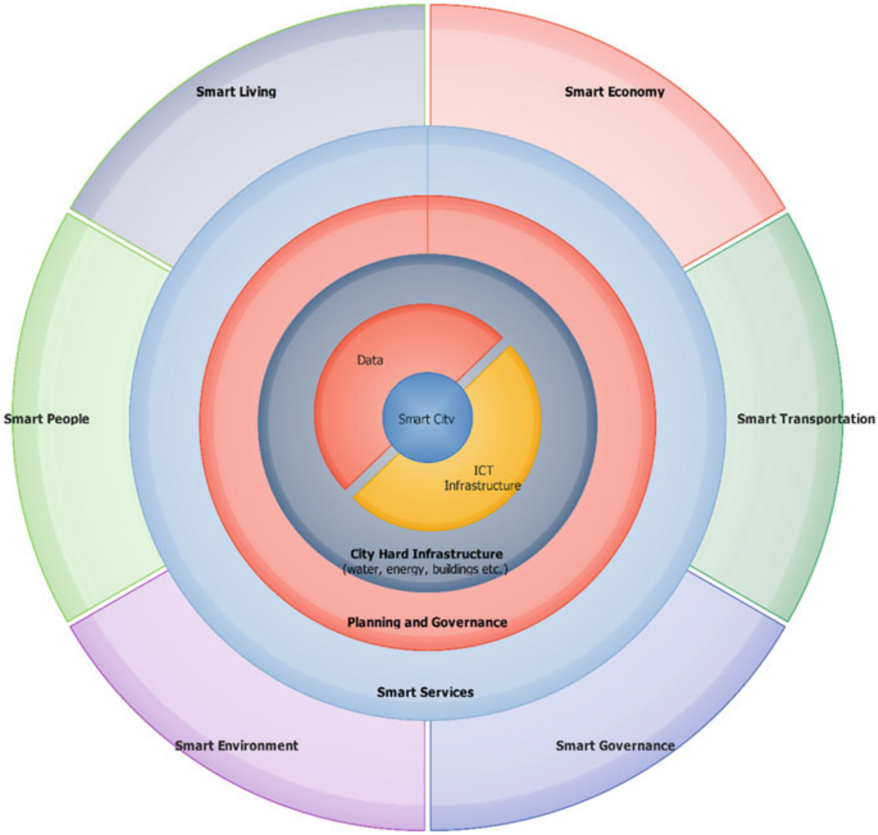


Fig. 2.2 Smart city conceptual system

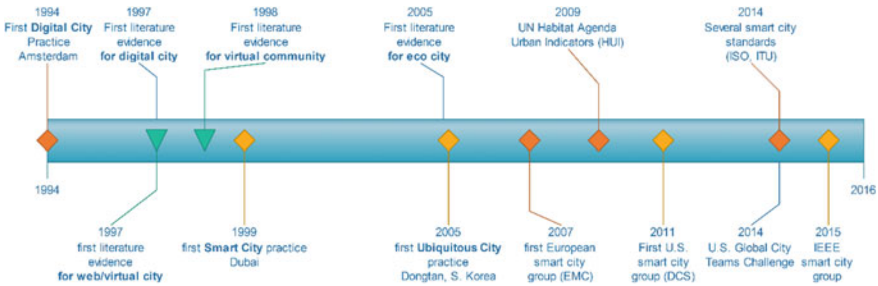


Fig. 2.3 Smart city evolution timeline

"public-arenas", especially in cities where the lack of public space, the growing violence, fear alienation and the reduction in civic associations do not enable public interaction, but instead they enhance "urban privatism". Web or Virtual cities drew together all web activities in a city or simulated a city on the web and they were configured as little more than urban databases that provided public information for the municipal authorities to even transport and leisure data, cultural events and tourist guides. Virtual cities concerned the first attempt that utilized the potential of the Internet for supporting local democracy and enabled urban marketing, new types of electronic municipal service delivery, local inter-firm networking, and social and community development within cities. However, an absence of citizens was documented, whose feedback was supposed to be necessary to establish.

The same work (Graham and Aurigi 1997) introduced the term ***digital city*** too, which was a more socially inclusive and discourse driven virtual city. In this respect, the first forms of digital cities included thematic spaces for citizen interactions. Digital city was mentioned in the second work, only a year later by van den Besselaar and Beckers (1998), who named the term as a large infrastructure for virtual communities. Communities concern associations between people, which are coordinated through communication based on shared norms and interests. The above definition demonstrates that digital city is a broader term, compared to community networks, since digital city's scope is wider (it is not focused on a specific urban space) and it can deliver services to non-community members that would like to register them. Moreover, this work mentioned the Internet-enabled community structure that exceeds the physical space, which limits locality. Instead, local communities are the ones that share common interests (special interest groups). The first digital city practice was implemented in Amsterdam[1] in 1994 as the result from an activists' effort, with the aim to enable dialogue between community and politicians. It was a success story since the citizens adopted progressively the effort, while it was accompanied by the implication of stimulating Internet penetration in the city.

The above evidence shows that both *virtual* and *digital* smart city types initiated an approach to handle similar challenges with similar technological means: they aimed to create communities with the use of the ICT in an attempt to socialize inhabitants, to democratize local governments and to utilize virtual places against the lack of public space. In this respect, the Internet, combined with urban network infrastructure and the WWW were used to develop city websites, which offered alternative smart services mainly regarding *information retrieval* (e.g., city guides, information for transportation, government political information's and forms' sharing, employment opportunities etc.), *synchronous* (chatting, debates and gaming) and *asynchronous communication* (e-mail, discussion groups and billboards). These two initial smart city approaches simulated the urban space either as connected islands of communities (community of communities) or even as two-dimension (2D) or three-dimension (3D) virtual spaces. From organization point of view, both these two types started as bottom-up initiatives from users that shared common interests, but by 1997 they evolved to not-for-profit organizations with turnovers (e.g., the Amsterdam digital city of about $0.5 US million in 1997

[1]Amsterdam digital city or DDS (De Digitale Stad, Dutch for The Digital City).

and 25 employees) led by municipalities. Another famous digital city case was Kyoto (Ishida 2017), which was launched in 1998 and resulted to 2D and 3D spaces, where citizen interactions could be collected with sensors (cameras) and reproduce with animation their behavior.

The *digital city* concept became synonymous to ***information city***, which was understood as a metropolitan environment where the ICT is the key driver in delivering innovative online services (Lee et al. 2014). The notion of *digital* or *information* city was later evolved to the ***ubiquitous city*** where data is ubiquitously available through an embedded urban infrastructure (e.g., through equipment embedded in streets and other urban hard facilities) (Anthopoulos and Fitsilis 2014). The term originates from the South Korean government, who refer to "a city that is managed by the network and provides … citizens with services and contents via the network … with a BUCI (fixed u-City infrastructure) and MUCI (mobile u-City infrastructure), built on high-end technologies such as sensors" (Lee et al. 2014). Another term which is also being discussed is the ***intelligent city***, which focuses on the city performance regarding producing innovation in the following three dimensions: (1) Intelligence, inventiveness and creativity; (2) Collective intelligence and (3) Artificial intelligence (Lee et al. 2014).

The above smart city types evolved steadily to more "sophisticated" ecosystems, which are able to offer more intelligent services and enable technological embeddedness. Anttiroiko et al. (2014) explain *technological embeddedness* as the ability of technology to embed in social systems in order to achieve in smart service delivery. Level of embeddedness ranges from simple information delivery (low), which increases to intelligent system implementation (functionality), then to systems that deal with social and human concerns (quality of life) and to ecological systems (sustainability) (Anttiroiko et al. 2014). *Ecosystems* on the other hand, are generally defined as communities of interacting organisms and their environments, and are typically described as complex networks formed because of resource interdependencies (Gretzel et al. 2015). An ecosystem can be seen as "an interdependent social system of actors, organizations, material infrastructures, and symbolic resources" (Maheshwari and Janssen 2014). In this respect, ecosystems, like other kinds of systems, are comprised of elements, interconnections and a function/purpose, but are special types of systems in that their elements are intelligent, autonomous, adaptive agents that often form communities and also because of the way they adapt to elements being added or removed. According to this definition, four critical elements exist in ecosystems: (1) interaction/engagement; (2) balance; (3) loosely coupled actors with shared goals; and, (4) self-organization (Gretzel et al. 2015).

Today, almost all cities claim to be more or less smart with an underlying self-congratulatory tendency (Hollands 2008), obviously with regard to a different level of technological embeddedness or due to the existing intelligent capacity that a city holds. In an attempt to overcome this self-congratulatory "smart labeling", scholars like Hollands (2008) have emphasized on the existence of embedded ICT (interconnected, instrumented and smart) that enable data flow, while others—e.g., the ones compared by Anthopoulos et al. (2016)—have developed benchmarking

Table 2.2 Smart city coalitions and groups of study

	Coalition/group	Description—source	Year	Scope
1.	Innovation Cities^{TM} (IC)	2thinknow (www.2thinknow.com)	2011	Global (330 cities)
2.	Eurocities	Network of major European cities (http://www.eurocities.eu)	1986	Europe (130 European largest cities from 35 countries)
3.	Smart Cities—European Medium Sized Cities (EMC)	Three European university-based research centers[a] (http://smart-cities.eu/)	2007	Europe
4.	Market Place of the European Innovation Partnership (EIP) on smart cities and communities	Initiative supported by the European Commission bringing together smart city actors (https://eu-smartcities.eu)	2011	Europe (4000 partners from 31 countries)
5.	E-Forum	Not-for-profit association active in e-government, e-Identity and EU-China Smart City development (www.eu-forum.org)	2001	Europe
6.	Green Digital Charter	Commits cities to reduce emissions through ICT and promote progress in tackling climate change through the innovative use of digital technologies in cities. Works under Eurocities (http://www.greendigitalcharter.eu/)	2009	Europe (cities from 21 countries)
7.	Global Cities Dialogue on Information Society (GCD)	Non-profit international association of Mayors and High Political Representatives (http://globalcitiesdialogue.com/)	1999	Global (over 200 cities)
8.	Digital Cities Survey (DCS)	Center for Digital Government (www.centerdigitalgov.com/)	2011	U.S.A.
9.	UN-Habitat Agenda Urban Indicators (HUI)	UN Habitat[b]	2009	Global
10.	Smarter City Assessment Model (IBM model)	IBM[c]	2009	General
11.	IEEE Core Smart Cities	IEEE[d]	2015	Global (5 core cities and 7 affiliated)

(continued)

Table 2.2 (continued)

	Coalition/group	Description—source	Year	Scope
12.	City Resilience Profiling Programme (CRPP)	UN Habitat (https://www.cityresilience.org/CRPP)	2012	Global (10 cities)
13.	Alcatel-Lucent smart city analysis	Alcatel-Lucent[e]	2012	Global (52 cities)
14.	Global City Teams Challenge	U.S. National Institute of Standards and Technology, US-Ignite (http://www.nist.gov/cps/sagc.cfm)	2014	U.S.A.
15.	MIT Media Lab Cities Network	MIT Media Lab (http://cities.media.mit.edu/living-labs/)	2014	Global (3 cities)
16.	Smart Cities Council	Smart Cities Council is an advisor and market accelerator (http://smartcitiescouncil.com/)	2012	Global
17.	Smart to Future Cities	Ovum TMT Intelligence, Informa (https://smarttofuture.com/)	2014	UK, Global
18.	City Protocol	Collaborative innovation framework (http://cityprotocol.org/)	2015	Global
19.	The Open and Agile Smart Cities (OASC) Initiative	City-driven, non-profit organization (http://oascities.org)	2015	Global
20.	International Council for Local Environmental Initiatives (ICLEI)	ICLEI smart city[f]	2016	Global
21.	World Council on City Data (WCCD)	Global leader in standardized city data (http://www.dataforcities.org/)	2014	Global
22.	Global Cities Institute (GCI)	At the University of Toronto (http://www.globalcitiesinstitute.org/)	2008	Global (255 cities, 82 countries)
23.	The Global City Indicators Facility	Program of the Global Cities Institute (http://cityindicators.org/)	2008	Global
24.	CITYNET	City network in the Asia Pacific with the support of United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the United Nations Centre for Human Settlements (http://citynet-ap.org/)	1987	Asia Pacific

(continued)

Table 2.2 (continued)

	Coalition/group	Description—source	Year	Scope
25.	Cities Alliance	Global partnership for urban poverty reduction and the promotion of the role of cities in sustainable development (http://www.citiesalliance.org/)	1999	Global
26.	United Cities and Local Governments (UCLG)	Represents and defends the interests of local governments on the world stage (https://www.uclg.org)	2004	Global (more than 1000 cities from 95 countries)
27.	The World Association of Major Metropolises (Metropolis)	An international association of global cities working towards developing solutions to issues affecting large cities. It serves UCLG (http://www.metropolis.org/)	1985	Global (137 global cities)
28.	The Council of Local Authorities for International Relations (CLAIR)	A joint organization made up of local governments (http://www.clair.or.jp/e/)	1988	Japan
29.	Centre for Liveable Cities (CLC) Singapore	With the support of the Ministry of National Development and the Ministry of the Environment and Water Resources (http://www.clc.gov.sg/)	2008	Singapore
30.	C40 Cities Climate Leadership Group (C40)	C40 is a network of the world's megacities committed to addressing climate change (http://www.c40.org/)	2006	Global (80 of the world's greatest cities)
31.	World Resources Institute (WRI) Ross Center for Sustainable Cities	Global research and on-the-ground experience for urban sustainability (http://www.wrirosscities.org/)	2014	Global
32.	Coalition for Urban Transitions	International initiative to enhance national economic, social, and environmental performance, including reducing the risk of climate change (hosted at WRI) (http://www.coalitionforurbantransitions.org/)	2013	Global

(continued)

Table 2.2 (continued)

	Coalition/group	Description—source	Year	Scope
33.	The International Society of City and Regional Planners (ISOCARP)	Global association of experienced professional planners, recognized by UN, UNHCS and Council of Europe (http://isocarp.org/)	1965	Global
34.	World e-Governments Organization of Cities and Local Governments (WeGO)	International cooperative body of cities and local governments that pursues sustainable city development based on e-Government (http://www.we-gov.org/)	2008	Global (97 Cities)
35.	Energy Services Network Association (ESNA)	Independent global, not-for-profit association under Dutch law. Members share the same goal and vision and are utilities, software, hardware and service providers, and solution integrators (http://www.esna.org/)	2006	Global (32 companies)
36.	6Aika or the Six City Strategy	A cooperation strategy between the six largest cities in Finland (Helsinki, Espoo, Vantaa, Tampere, Turku, and Oulu), with regard to generate new expertise, business operations, and jobs and focus on open innovation platforms, open data and interfaces, and open participation (http://6aika.fi/)	2014	Finland (6 cities)
37.	Internet of Things Council	Thinktank for the Internet of Things (http://www.theinternetofthings.eu/)	2009	Europe
38.	Sister Cities International	Nonprofit organization, which serves as the U.S. membership organization for individual sister cities, counties, and states (http://sistercities.org/)	1956	U.S./Global (570 member communities)

(continued)

Table 2.2 (continued)

	Coalition/group	Description—source	Year	Scope
39.	Alberta Smart City Alliance	Cross-sector collaboration between community leaders and city builders, forward-thinking governments, corporations, entrepreneurs, and academic innovators (https://smartcityalliance.ca)	2014	Canada (110 members with 12 cities and 30 towns)
40.	Asian Cities Climate Change Resilience Network (ACCCRN)	Comprises practitioners and institutions committed—under the Rockefeller Foundation—to creating knowledge, accessing resources, and influencing agendas to build inclusive urban climate change resilience (http://acccrn.net/)	2008	Asia (50 cities)
41.	Smart Cities Smart Government Research-Practice (SCSGRP) Consortium	Global Smart Cities research community that focuses on innovations in technology, management and policy that change the fabric of the world's cities (https://www.ctg.albany.edu/projects/smartcitiesconsortium)	2012	Global (at the University of Albany)
42.	Open and Agile Smart Cities (OASC)	City-driven, non-profit organization. (http://www.oascities.org/)	2015	Global (more than 30 cities)

[a]The Center of Regional Science at Vienna University of Technology, the Department of Geography at the University of Ljubljana, and Research University of Housing, Urban and Mobility Studies at Delft University of Technology
[b]www.unhabitat.org/downloads/docs/Urban_Indicators.pdf
[c]http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/
[d]http://smartcities.ieee.org/home/core-cities.html
[e]http://www.tmcnet.com/tmc/whitepapers/documents/whitepapers/2013/6764-getting-smart-smart-cities-market-analysis.pdf
[f]http://www.iclei.org/activities/agendas/smart-city.html

models for smart city to measure corresponding progress or existing capacity. Moreover, the above conceptualization models have been utilized by many smart city cases, recent studies have been employed by many smart city coalitions, while more than 300 smart cities are mentioned by studies and business reports (Table 2.2).

2.4 City and Smart City Classes

Several city classes were presented in the previous sections, which aggregate cities according to their *population and density* (village, community, town, city and megacity), to their *impact* (local and global cities) and to their *development stage* (new and existing cities).

On the other hand, the extreme smart city growth that has been performed during the last 20 years has created various alternative smart city types. For a beginning, Alcatel-Lucent (2012) classify smart cities in market-driven groups: "GreenFields" and "Brownfields" that display the size (large-scale cases compared to small-scale ones) of the smart city project; and to four different "box" types according to project organization and business model:

- *Information Technology (IT) box*: a private company initiates the smart city and private funding business model;
- *Dream box*: public-private partnership (PPP) for project definition and respective business model;
- *Fragmented box*: many projects initiated by various stakeholders with little or no integration; and
- *Black box*: initiated and managed by (local, state or national) Governments or public agencies, with "invited" companies to enter this ecosystem.

Additionally, Anthopoulos and Fitsilis (2014) made an analysis of 34 different smart cities and discovered alternatives that vary with regard to the ICT that has been embedded within the city and defines an alternative smart adjective to city. These alternatives determine several smart city classes, which range and mainly address the adjective that describes the particular ICT that is installed in the city. More specifically, the following classes can be located Anthopoulos and Fitsilis (2014) (Table 2.3):

- *Web or Virtual Cities*: offer local information, online chatting and meeting rooms, and city augmented reality navigation via the Web. Some indicative cases concern: America-On-Line (AOL) Cities (1997), Kyoto, Japan (1998–2001), Bristol, U.S.A. (1997) and Amsterdam (1997).
- *Knowledge Bases* (van Bastelaer 1998) or *Knowledge Cities:* are digital public repositories with crowd sourcing options accessible via the Internet and via text-TV (Copenhagen Base (1989); Craigmillar Community Information Service, Scotland (1994); and Blacksburg Knowledge Democracy). Later approaches by Edvinsson (2006), Yigitcanlar et al. (2008) define knowledge city as locally focused innovation, science and creativity within the context of an expanding knowledge economy and society. This later approach has been followed by Melbourne.
- *Broadband City/Broadband Metropolis*: describe fiber optic backbones in the urban area, which enable the interconnection of households and of local enterprises to ultra-high speed networks. Seoul, S. Korea (1997); Beijing, China (1999); Helsinki (1995); Geneva-MAN, Switzerland (1994) (van Bastelaer 1998); and Antwerp comprised this category.

Table 2.3 Smart city classes and representatives (Anthopoulos and Fitsilis 2014)

Category	Representatives and year of their appearance	Explanation/current state
Web/Virtual City	1. **America-On-Line (AOL) Cities** (1997) 2. **Kyoto**, Japan (1996–2001) http://www.digitalcity.gr.jp 3. **Bristol, U.S.A.** (1997) 4. **Amsterdam** (1997)	1. **America-On-Line (AOL) Cities** City Guides for U.S. cities http://www.citysbest.com 3. **Bristol, U.S.A.** http://www.digitalbristol.org/ 6. **Craigmillar Community Information Service** Scotland http://www.s1craigmillar.com
Knowledge Bases	5. **Copenhagen Base** (1989) 6. **Craigmillar Community Information Service**, Scotland (1994) 7. **Blacksburg Knowledge Democracy**, U.S.A. (1994)	
Broadband City/Broadband Metropolis	8. **Seoul**, S. Korea (1997) 9. **Beijing**, China (1999) 10. **Helsinki** (1995) 11. **Geneva-MAN**, Switzerland (1994) 12. **Antwerp**, Belgium (1995)	11. **Geneva-MAN**, Switzerland
Wireless/Mobile City	13. **New York** (1994) 14. **Kista Science City/Stockholm** (2002) 15. **Florence**, Italy (2006)	13. **New York** http://www.nyc.gov/html/doitt/ 14. **Kista Science City/Stockholm** http://en.kista.com 15. **Florence**, Italy http://senseable.mit.edu/florence/
Smart City	16. **Taipei**, Taiwan (2004) 17. **Tianjin**, China (2007) 18. **Barcelona**, Spain (2000) 19. **Brisbane**, Australia (2004) 20. **Malta** (2007) 21. **Dubai** (1999—today) 22. **Kochi**, India (2007)	10. **Helsinki** http://www.hel.fi 12. **Antwerp**, Belgium Evolved from Broadband City; it is interconnected to Brussels and to Amsterdam; offers its infrastructure with the open access business model; it operates under the Municipality and invites private investments 19. **Brisbane**, Australia http://www.brisbane.qld.gov.au 20. **Malta** http://malta.smartcity.ae/ 21. **Dubai** www.dubaiinternetcity.com, www.dubaimediacity.com 22. **Kochi**, India http://www.smartcity.ae

(continued)

Table 2.3 (continued)

Category	Representatives and year of their appearance	Explanation/current state
Digital City	23. **Hull**, U.K. (2000) 24. **Cape Town**, South Africa (2000) 25. **Trikala**, Greece (2003) 26. **Tampere**, Finland (2003) 27. **Knowledge Based Cities**, Portugal (1995) 28. **Austin**, U.S.A. (1995—today)	9. **Beijing**, China It evolved from a broadband city 7. **Blacksburg Electronic Village**, U.S.A. It updated its mission and evolved from a knowledge base http://www.bev.net/ 23. **Hull**, U.K. http://www.hullcc.gov.uk 24. **Cape Town**, South Africa http://www.capetown.gov.za 25. **Trikala**, Greece Exists and limited its scope to tele-care and to metro-Wi-Fi services www.e-trikala.gr 26. **Tampere**, Finland It began as a thinking tank for innovative ICT applications. Today it occupies more than 1000 professionals who develop various e-Services http://www.tampere.fi 27. **Knowledge Based Cities**, Portugal Portals of the digital cities have not met projects' objectives http://www.cidadesdigitais.pt
Ubiquitous City	29. **New Songdo**, S. Korea (2008) 30. **Dongtan**, S. Korea (2005) 31. **Osaka**, Japan (2008) 32. **Manhattan Harbour, Kentucky**, U.S.A. (2010) 33. **Masdar**, United Arab Emirates (2008) 34. **Helsinki Arabianranta**, Finland (2005)	8. **Seoul**, S. Korea Evolved from a broadband city and operates under a coalition of public and private stakeholders (Korean Ministry of Information and Communications, 2007) 29. **New Songdo**, S. Korea http://www.songdo.com 31. **Osaka**, Japan http://www.osakacity.or.jp 32. **Manhattan Harbour, Kentucky**, U.S.A. http://www.manhattanharbour.com 34. **Helsinki Arabianranta**, Finland Operated as a living lab http://www.arabianranta.fi/

(continued)

Table 2.3 (continued)

Category	Representatives and year of their appearance	Explanation/current state
Eco City		4. **Amsterdam** It evolved to other approaches (broadband, smart, eco-city) http://www.amsterdamsmartcity.com 5. **Copenhagen** It has evolved from a knowledge base http://www.kk.dk 16. **Taipei**, Taiwan It has evolved from a Smart City http://english.taipei.gov.tw/ 17. **Tianjin (Singapore)**, Public housing project in the Eco-city and Keppel District Heating and Cooling System Plant http://www.tianjinecocity.gov.sg 18. **Barcelona**, Spain Evolved from a Smart City http://w3.bcn.es, http://www.bcn.es 28. **Austin**, U.S.A. It began as a digital city and emerged to Eco City http://www.cityofaustin.org/ 33. **Masdar**, United Arab Emirates Evolved from a ubiquitous city http://www.masdarcity.ae 30. **Dongtan** S. Korea Evolved from a ubiquitous city

- *Mobile/Wireless/Ambient Cities* are wireless broadband networks accessible across the city or in some districts. New York City (1994); Kista Science City/Stockholm (2002) and Florence, Italy (2006) were the identified representative members.
- *The Digital or Information City* describes an ICT environment across the city that is built to deal with: (a) local needs and transactions, (b) the transformation of the local community to a local information society, and (c) sustainable local development. Hull, U.K. (2000); Cape Town, South Africa (2000); Trikala, Greece (2003); Tampere, Finland (2003); Knowledge Based Cities, Portugal (1995); and Austin, U.S.A. (1995—today) are members of this group.
- *The Ubiquitous City* extends the digital or information city in enabling ubiquitous service provision and data flow from anywhere to everyone. New Songdo, S. Korea (2008); Dongtan, S. Korea (2005); Osaka, Japan (2008); Manhattan Harbour, Kentucky, U.S.A. (2010); Masdar, United Arab Emirates (2008); and Helsinki Arabianranta, Finland (2005) are some representatives.
- *The smart city* came to extend ubiquitous city in a sense that emphasized social infrastructure (human and social capital, named the dimension of *people*) of the

city (Lee et al. 2014). This approach offers broadband and media infrastructures for business growth too. Taipei, Taiwan (2004); Tianjin, China (2007); Barcelona, Spain (2000); Brisbane, Australia (2004); Malta (2007); Kochi, India (2007); and Dubai (1999—today) were labeled "smart" from their initial appearance.

- Finally, the *Eco City* extends ubiquitous city with a service agenda that respects the physical landscape of the city or in other words it capitalizes the ICT for sustainable growth and for environmental protection.

As it can be seen on (Table 2.3), many members of the above classes did not remain in a specific group but shifted from a class to another, even more than once. In an attempt to recognize whether these changes suggest a technological evolution or patterns of change, Anthopoulos and Fitsilis (2013) performed an analysis of the types of smart services that 29 of the above cases offer and structured nine (9) smart service groups (SG), inspired by (Alcatel-Lucent 2012) market-driven groups:

- *SG1: e-Government services* (City Administration market-driven group) concern typical public transactions (offered by digital, smart and ubiquitous city classes).
- *SG2: e-democracy services* (City Administration market-driven group), like dialogues, consultation, polling and voting than enhance citizen engagement (offered by virtual, digital, smart and ubiquitous city classes).
- *SG3: smart business services* (Real estate market-driven group), that concern business installations' support or digital marketplaces and tourist guides (met in digital and smart city classes).
- *SG4: smart health and tele-care services* (Healthcare market-driven group) offer distant telematics support to groups of citizens (e.g., elderly people) (appear in digital and smart city classes).
- *SG5: smart security services* (Public Safety market-driven group) that enhance public safety and emergency (ubiquitous city class).
- *SG6: smart environmental services* (Utilities market-driven group) address environmental protection and mainly concern waste collection and recycling, emission control, as well as utility services (e.g., energy and water) (met in ubiquitous and eco-city approaches).
- *SG7: intelligent transportation* (Transportation market-driven group) concern traffic control and public transportation optimization (offered by digital and smart city approaches).
- *SG8: typical telecommunication services* (Real estate market-driven group) such as broadband connectivity, digital TV etc. (offered by broadband, mobile, digital, smart and ubiquitous approaches).
- *SG9: smart education services* (Education market-driven group), that concern distant learning services and online libraries (available in smart and digital city approaches).

The concept of smart service classification was that when a smart city "migrates" from one class to another, a corresponding change to the offered services is being performed and vice versa. Moreover, the only means to discover in which class a smart city belongs is to investigate literature (publications and reports) and the types of services that the city offers (either with person visits or according to the official websites). In this respect, Anthopoulos and Fitsilis (2013) concluded to the following findings (Table 2.4).

The next step was to observe when a shift from a service group to another occurred, which concerns a corresponding shift to a different smart city class (Fig. 2.4).

Except from literature findings, Anthopoulos and Fitsilis (2013) utilized data from personal visits and the official websites of the investigated cases (Table 2.3), which were processed with the technology roadmapping method and resulted to a demonstration of smart city classes evolution (Fig. 2.5).

Data from (Tables 2.3 and 2.4) show that most smart cities did not retain their initial technological type but they evolved to different forms. Moreover, this data extract path-dependent roadmaps (Li et al. 2009) of (Fig. 2.6), which demonstrate smart city updates and how each change depends on its own past. Path dependency can explain smart city evolution on the basis of smart service provision, while paths do not demonstrate co-existences of cases in more than one groups (e.g., Trikala simultaneously belonged to SG6, SG7 and SG8). Moreover, SG1, SG2, SG3 and SG8 are root nodes, while SG6 is an end-node, illustrating that this smart city type (environmental services) has not evolved to a different approach yet. Furthermore, these smart city classes meet market-driven approaches and this assignment depicts that various projects are mostly preferred (fragmented box) at an international level, while PPP (Dream box) and private (IT box) initiatives follow.

Technology roadmapping for these smart service groups shows that the smart city evolution did not pass though all classes, neither cities have evolved from all classes to all the others. On the contrary, seven (7) path-dependent roadmaps can be observed (Fig. 2.4):

1. SG1-SG3-SG7-SG6
2. SG1-SG5-SG7-SG6
3. SG1-SG3-SG5-SG7-SG6
4. SG2-SG4-SG5-SG7-SG6
5. SG8-SG6
6. SG9-SG7-SG6
7. SG9-SG6

This finding can be interpreted by the following hypotheses: (a) not all smart city technological approaches are suitable to be followed by all urban areas, but various parameters could determine to which direction a smart city must evolve. However, it is beyond the purpose of this chapter to determine these variants. (b) Not all approaches have attracted smart city technological evolution, but environmental smart service provision appears to be preferable, which sounds normal after the emphasis that international organizations give on climate change effects and urban sustainable future. Furthermore, smart cities that provide smart business, broadband and transportation services have also been popular. Finally, (Fig. 2.5) illustrates the evolution timeline of the alternative smart city classes, where five of them still exist.

Table 2.4 Smart city classification (Anthopoulos and Fitsilis 2013)

Case	Started	Smart service class	Market-driven class
AOL cities	1997	Online city guides, information from local enterprises (SG3)	BrownField, IT Box
Digital city of Kyoto	1996	GIS information about the city, city guide, municipal transportation, crowd sourcing, 3D Virtual Tour (SG3)	BrownField, IT box
Bristol	1997	Advertising spaces, connection with citizen's personal sites, public information (SG1, SG2, SG3)	GreenField, dreambox box
Amsterdam	1997	Energy management, smart building, tele-presence conference centers, grid energy solutions, sustainable public spaces, sustainable working (SG1, SG6, SG7, SG8)	GreenField, Fragmented Box
Copenhagen	1989	Local e-Government services, national e-Government services, city guide, e-Parking services, guides for entrepreneurship (SG1, SG2, SG3, SG7)	GreenField, Fragmented Box
Craigmillar	1994	Self-recycle services, local online news, job opportunities in the city Marketplace for cars and property (SG6, SG7)	BrownField, IT Box
Blacksburg	2001	GIS services, crowd sourcing, MAN, 3D Virtual city model with crowd sourcing options, broadband services, online guides and training for entrepreneurs (SG2, SG3, SG8)	BrownField, IT Box
Seoul	1997	Wired and Wireless broadband internet services, digital mobile TV (SG8)	GreenField, Dream Box
Beijing	1999	Wired and Wireless Broadband Services, smart olympic buildings (SG8)	GreenField, Fragmented Box
Helsinki	1995	Regional map service, WLAN hot spots, e-health cards (SG3, SG4, SG8)	GreenField, Dream Box
Geneva	1994	Wired and Wireless Broadband Services, Public Information and public service guides, Tourist Guides, Job Opportunities (SG1, SG3, SG8)	GreenField, Dream Box
Antwerp	1995	e-Government services (e-Counter), Online Tourist Guide, e-Booking Property Database, environmental information and guides for entrepreneurs (SG1, SG3, SG6)	GreenField, Fragmented Box
New York	2004	Wireless broadband services, e-Government portal, GIS city information (SG1, SG8)	BrownField, IT Box

(continued)

Table 2.4 (continued)

Case	Started	Smart service class	Market-driven class
Stockholm (Kista)	2002	Residential parking permits, e-government services, elderly care treatment (SG1, SG6, SG8)	GreenField, Fragmented Box
Taipei	2004	Intelligent transportation, e-parking, 3D website for virtual tours, public e-Services, e-Future classroom (SG1, SG3, SG9)	GreenField, fragmented box
Dongtan	2005	Eco services like smart grids, energy/water/waste smart management, green buildings (SG6)	GreenField, fragmented box
Tianjin	2007	Eco services like smart grids, energy, water and waste smart management, green buildings (SG6)	GreenField, fragmented box
Barcelona	2000	e-Government services, mobile services, online city guide, guides for entrepreneurs, Intelligent transportation, open data from city council (SG1, SG3, SG7)	GreenField, fragmented box
Hull (U.K.)	2000	e-Government information and e-Services, GIS maps (SG1)	GreenField, fragmented box
Trikala	2003	Tele-care services, intelligent transportation, wireless broadband services (SG6, SG7, SG8)	BrownField, black box
Brisbane	2004	e-Parking, e-Government services, mobile services, e-Procurement services via national portal, virtual communities (SG1, SG2, SG7)	BrownField, fragmented box
Malta	2007	Smart grids (SG6)	BrownField, fragmented box
Dubai	1999	Media services, e-Education, e-Commerce, Develops business services (SG3, SG9)	BrownField, black box
New Songdo	2008	Intelligent buildings, ubiquitous computing, local information (SG6, SG8)	GreenField, dream box
Osaka	2008	Tourist guides, public information, guides for entrepreneurs (SG1, SG3)	GreenField, dream box
Manhattan Harbour, Kentucky	2010	Intelligent Buildings, Ubiquitous computing (SG6, SG8)	GreenField, Fragmented Box

(continued)

Table 2.4 (continued)

Case	Started	Smart service class	Market-driven class
Masdar	2008	Renewable resources and smart energy management (SG6)	GreenField, dream box
Cape Town	2000	Environmental services, tourist guides, intelligent transportation (SG3, SG6, SG7)	GreenField, dream box
Knowledge based cities	1998	Broadband and telecommunications services, online city guides, public information (SG1, SG2, SG3)	BrownField, IT Box

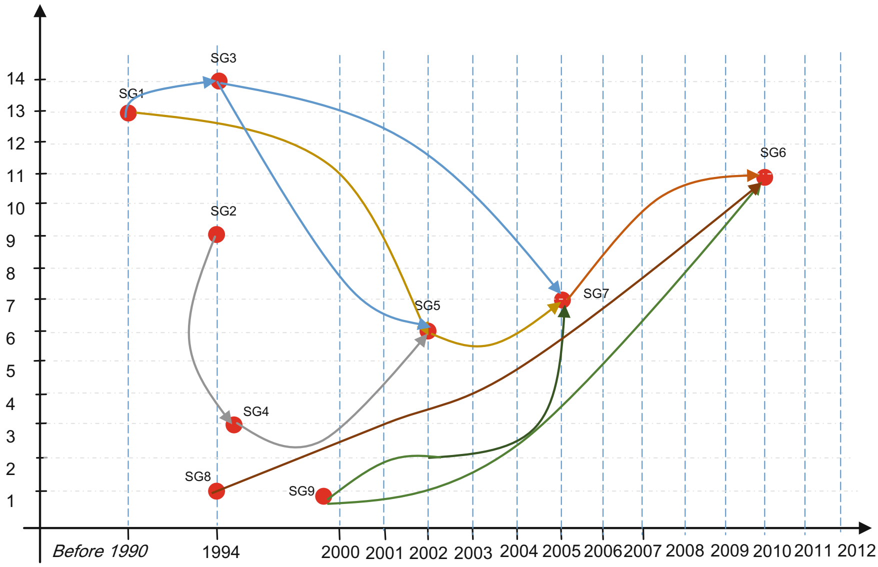


Fig. 2.4 Smart city evolution according to (Table 2.4)

The reasons that lie behind this evolution are not clear. Probably technological evolution of corresponding ICT is the primary reason or that the smart city owners eager to offer more sophisticated smart services. Anthopoulos and Fitsilis (2013) grounded a theory that viability—the "feasibility and the operational continuity of an organization, a business, a facility or a project's outcome in political, social, legal, environmental, economic, and financial terms"—is the primary reason. In this respect, a smart city evolves in order to sustain against radical changes, coming both from internal (e.g., service demand, political willing etc.) and external sources (e.g., city competition, climate change etc.). However, this theory remains to be validated.

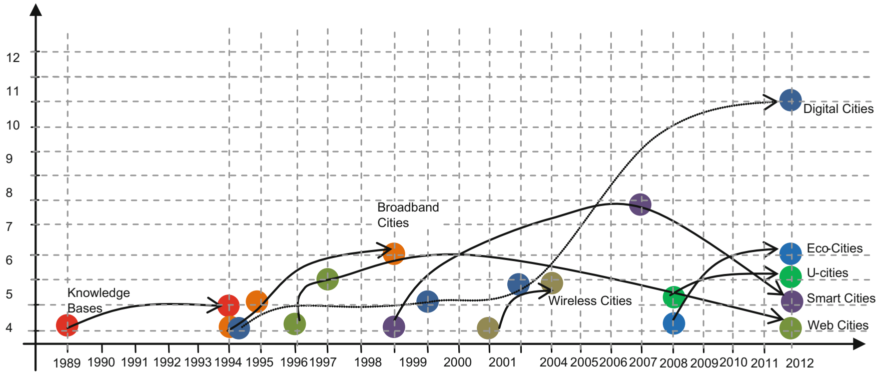


Fig. 2.5 Smart city class evolution according to (Table 2.3)

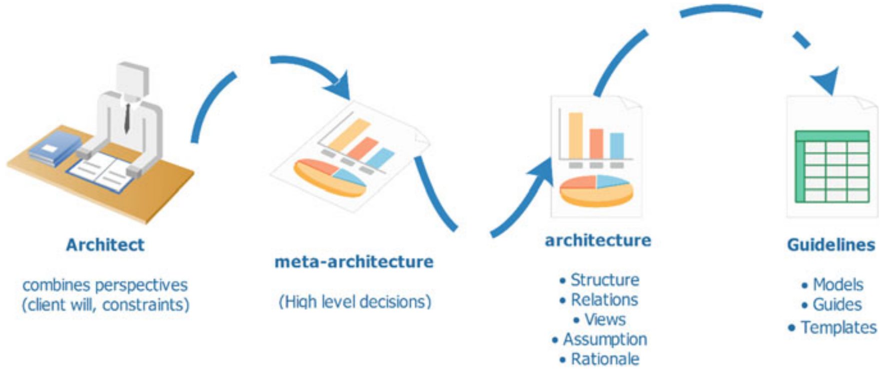


Fig. 2.6 ICT architecture development methodology

2.5 Smart City Architecture

The term architecture describes several technological aspects, which range from information structure to technology delivery or ICT management (Perks and Beveridge 2003; McGovern et al. 2003). However, the most familiar use for the term concerns the formulation of physical structures such as systems or buildings. In this respect, architecture concerns *a definition of the structure, relationships, views, assumptions and rationale of a system.*

According to this definition, the architecture concerns something with a defined structure (e.g., a building is based on solid and coherent purpose and use). The building's architect has to respect several aspects, ranging from the client's will, site's requirements, legal and financial constraints, technology limitations, the building's users etc. In this sense, the architecture concerns *a pragmatic, coherent structuring of a collection of components that through these factors supports the vision of the full "user" in an elegant way.*

Following up the above definition, an ICT system has also an architecture, which offers the following features:

- It is used to define a single "system".
- It describes the functional aspects of the system.
- It concentrates on describing the structure of the system.
- It describes both the intra-system and inter-system relationships.
- It defines guidelines, policies, and principles that govern the system's design, development, and evolution over time.

Each system's component has to be defined with the same or alternative architectural practices (hardware, software, data flow, business flow, management, etc.), which can represent alternative architectural perspectives, which at high level synthesize the enterprise ICT architecture (Perks and Beveridge 2003):

- The *information architecture* deals with the structure and use of information within the organization, and the alignment of information with the organization's strategic, tactical, and operational needs.
- The *business systems architecture* structures the informational needs into a delineation of necessary business systems to meet those needs.
- The *technical architecture* defines the technical environment and infrastructure in which all information systems exist.
- The *software or application architecture* defines the structure of individual systems based on defined technology.

The definition of an ICT architecture has a lot to do with information collection and understanding of all the stakeholders' needs, together with the limitations that come from the external environment and of the laws that impact the operation of system. As such, the following process is suggested to lead the architecture development (Fig. 2.6).

Since the smart city is based on the ICT for innovation production and development, its architecture development process has to respect the above methodology. From the above architecture types, *technical architecture* is of interest to demonstrate smart city synthesis (Anthopoulos 2015a, b; ITU 2014b), since it is the element which:

- describes and defines the structure of the environment in which business systems are delivered;
- creates and maintains a set of core technology standards, with which the smart city organization can measure technology projects;
- is an organizational capability—the people within (and outside) the ICT organization who provide strategic technical advice;
- is a means of resolving organizational technical issues;
- sets system (and hence software architecture), project, and corporate technology direction;
- establishes a reasoned approach for the integration of technology and business systems;

- establishes a framework for technology procurement decisions;
- both provides input to and is driven from the ICT planning process;
- allows the organization to control technology costs;
- develops a clear understanding of an organization's critical technical issues;
- provides a governance structure to support the ongoing health of the organization's technical environment;

Following the methodology of (Fig. 2.6) the process for the smart city architecture definition consists of the following steps:

- Smart city meta-architecture definition.
- Smart city ICT architecture alternatives' definition.
- Smart city frameworks' and patterns definition.

The above process consists of the following steps (ITU 2014b):

1. *Needs' identification*: it concerns the realization of the existing city services. The ICT innovation addresses the enhancement of urban living in terms of people, quality of life (living), environment, governance, economy and mobility.
2. *Stakeholders Identification and Needs Analysis*: it determines stakeholders with their roles and responsibilities in smart city. Since stakeholders are the entities with special interest in the smart city, some of them can be considered to be *the local, regional and national governments; city service and utility providers; ICT companies; Non-Government Organizations (NGOs); international, regional and multilateral organizations (e.g., United Nations, standardization bodies* etc.*); industry associations; academia; citizens and communities;* and *urban planners*.
3. *Scope definition*: it specifies space (geographic area) and time (duration) for the architecture. The applied ICT has to respect both *hard* (e.g., networks of transport, water, waste, energy etc.) and *soft* (e.g., social and human capital; knowledge, inclusion, participation, social equity, etc.) urban infrastructure, while it has to be applicable both on *new* and *existing* cities or districts. Finally, the applied solutions have to comply with all smart city classes (from *virtual* to *eco cities*).

    1. *Architectural principles' definition*: it specifies the principles that the architecture respects. The architecture has to be applicable on *different geographic areas*; *alternative technological artefacts* that are already installed in the city (e.g., legacy systems and telecommunication networks); *city class* (small or big city, global or local city; and new or existing); and *different timeframes* within which the architecture is requested to operate (small communities evolve slower compared to global cities). In this regard, the architectural principles that the smart city architecture has to respect concern:

        a. *Layered structure*: it is proved to be the best manageable option and it is followed in most of the examined cases (Anthopoulos and Fitsilis 2014);
        b. *Interoperability* between alternative city solutions;

c. *Scalability*: able to scale-up and down;
d. *Flexibility*: able to adopt cutting edge technologies, while physical or virtual resources have to be rapidly and elastically adjusted to provide various types of smart services;
e. *Fault tolerant*: respect many quality attributes regarding system performance;
f. *Availability, manageability and resilience*: ensure service availability and recovery after disasters;
g. *Standards-based*: it should ensure contestability, replace ability, and longevity
h. *Technology and/or vendor independence*: the architecture must be open and compatible with alternative solutions.

4. *Functional Requirements' definition*: it identifies the subsystems that deliver the smart city services. The minimum set of functions that the architecture must ensure concern *cybersecurity, data protection and cyber resilience; privacy; integrated management; hard infrastructure and environmental management; service delivery; and information flow.*
5. *Subsystem and Interface definition*: it demonstrates how the identified subsystems are connected and specifies the interfacing requirements. It is the outcome of the application of alternative architecture views (functional; implementation; physical; business process domain and software engineering).
6. *Dataflow Analysis*: it analyzes dataflow between smart city subsystems.
7. *Information Security and Privacy Requirements' definition*: it addresses all necessary information security requirements according to previously identified needs, functional requirements, interfaces and dataflow specifications for each subsystem.
8. *Systems Analysis and Final Design*: it analyzes potential merging of subsystems, as well as exclusion or inclusion of subsystem module.

The above process steps initially result to the definition of the smart city meta-architecture (Fig. 2.7), which incorporates the following components:

- **Soft infrastructure**: people, knowledge, communities, business processes etc.;
- **Hard infrastructure**: buildings, city facilities (e.g., roads, bridges, telecommunications networks etc.) and utilities (e.g., water, energy, waste, heat etc.);
- **ICT-based innovation**: both hardware and software solutions, which can be embedded in the above hard and soft infrastructure or deliver corresponding smart services;
- **Non-ICT based innovation**: innovation—beyond the ICT—that addresses smart city dimensions (e.g., creativity, open spaces, recycling and waste management, smart materials, organizational innovation in government, etc.)
- **Physical environment**: concerns the natural landscape of the city (e.g., ground, forests, rivers, mountains, etc.).

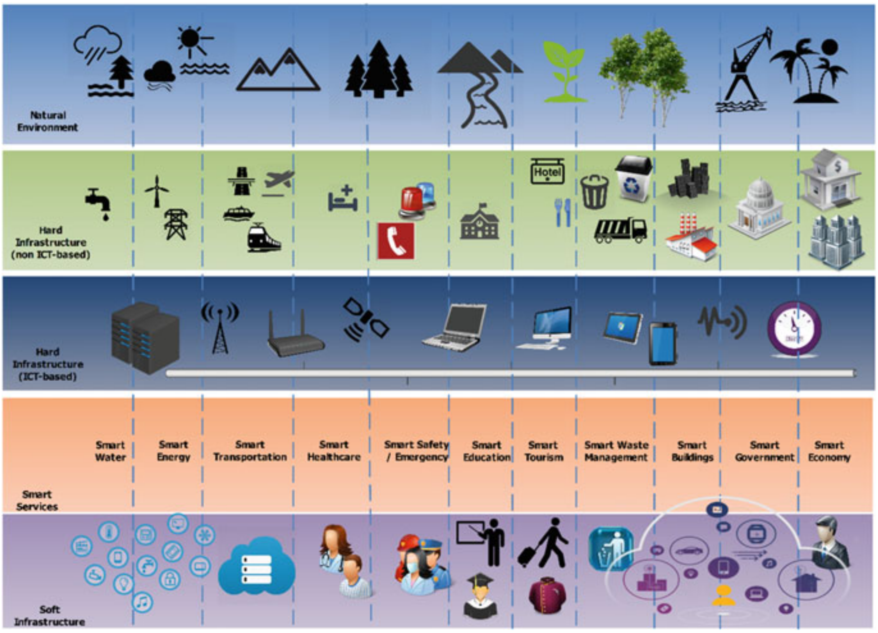


Fig. 2.7 Smart city meta-architecture

In this regard, the resulted multi-tier meta-architecture consists of the following layers from top to bottom (Fig. 2.6):

Layer 1—Natural Environment: respecting all the environmental features where the city is located.
Layer 2—Hard Infrastructure (Non ICT-based): it contains all the urban facilities (e.g., buildings, roads, bridges, energy-water-waste-heat utilities, etc.).
Layer 3—Hard Infrastructure (ICT-based): it concerns all hardware, with which smart services are being produced and delivered to the end-users (e.g., datacenters, telecommunication networks, IoT, sensors, etc.)
Layer 4—Smart Services: the smart services that are being offered via both the hard and soft infrastructure (e.g., smart safety, intelligent transportation, smart government, smart water management, etc.):

- Smart Transportation: e.g., parking management, intelligent transportation, traffic management, etc.
- Smart government: typical administrative procedures, service co-design platforms etc.
- Smart economy: typical intra-organization and inter-organization services, which are supported by the ICT (e.g., Enterprise Resource Planning (ERP) and

Customer Relationship Management (CRM) functions, online procurement systems, e-banking systems, etc.).
- Smart Safety and Emergency: accident management (e.g., traffic accidents), crime prevention, public space monitoring, climate effects' changes, alerting and emergencies (e.g., in cases of kidnapping and natural disasters, etc.).
- Smart health: tele-medicine, tele-care, health record management, etc.
- Smart Tourism: city guides, location based services, marketplaces, content sharing, etc.
- Smart Education: distance learning, digital content, digital libraries, ICT-based learning, ICT-literacy, etc.
- Smart Buildings: building performance optimization, remote monitoring and control, etc.
- Smart Waste management: monitoring, city waste management, emission control, recycling with the use of ICT, etc.
- Smart Energy: artificial lighting, smart grids, energy efficiency's management, etc.
- Smart water: quality measurement, water management, remote billing, etc.

Layer 5—Soft Infrastructure: individuals and groups of people living in the city, business process, software applications and data, with which the smart services are executed and being realized.

From the management view (service provider), all the offered smart services are being generated and transferred via separate subsystems. Each subsystem requires both infrastructure and software to operate, its uses and produced data, while it transacts with end-users (demand and supply side) and with other subsystems. In this respect, various types of transactions are being performed within the smart city architecture and between end-users and architecture subsystems. Indicatively, these transactions concern (ITU 2014b):

- Information and service requests (demand side end-users);
- Information and service delivery (supply side end-users and sub-systems);
- Information and service requests (demand side subsystems);
- Information and service delivery (supply side subsystems);
- Information storage (demand side subsystems);
- Information retrieval (supply side subsystems).

Individual interfaces allow transactions flows from/to a subsystem, while several user interfaces enable transactions with the end-users (demand and supply side). In order for the smart city architecture to be realized, a representative view is being presented, which concerns the communications view (ITU 2014b). This view is closer to the infrastructure developer and it examines the networking elements of the architecture in the nexus of geographic constraints, bandwidth requirements etc. Various alternatives can be followed to establish communications between smart city ICT architecture subsystems:

- Wired networks (fiber-optic, coal-based networks within the city, etc.) that structure wide, regional or local area networks;
- Wireless networks (WiFi, WiMax, GSM, 4G mobile networks, etc.);
- Peer-to-Peer connections between ICT architecture sub-systems;
- Distributed Object Management (DOM);

The communications view of the architecture is a multi-tier too and consists of the following layers (Fig. 2.7) (ITU 2014b):

- *Sensing layer*: consists of terminal node and capillary network. Terminals (sensor, transducer, actuator, camera, RFID reader, barcode symbols, GPS tracker, etc.) sense the physical world. They provide the superior "environment-detecting" ability and intelligence for monitoring and controlling the physical infrastructure within the city. The capillary network (including SCADA, sensor network, HART, WPAN, video surveillance, RFID, GPS related network, etc.) connects various terminals to network layer, providing ubiquitous and omnipotent information and data.
- *Network layer*: indicates facilities that are being provided by telecommunication operators, as well as other metropolitan networks provided by city stakeholders and/or enterprise private communication networks. It is the "infobahn", the network layer data and support layer: The data and support layer makes the city "smarter", its main purpose is to ensure support capabilities of various city-level applications and services. Data and support layer contains data center from industries, departments, enterprises, as well as the municipal dynamic data center and data warehouse, among others, established for the realization of data process and application support (Fig. 2.8).
- *Application layer*: The application layer includes various applications that enable the smart city management and deliver smart services.
- *Operation, Administration, Maintenance and Provisioning, and Security (OAM & P & security) framework*: ensures operation, administration, maintenance and provisioning, and security function for the ICT systems.

Except from the multi-tier architecture approach, a ***modular*** structure for a smart city can be also performed (ITU 2014b). However, modular definition is a complex process and it has to consider both the city type and the architecture view. Smart city soft infrastructure (people, data and applications) is flexible, extensible and easy to interconnect. On the contrary, hard infrastructure and physical environmental features place many restrictions in modular definition. Except from the previously presented conceptual models, various attempts to a modular smart city architecture (Cruickshank 2011; Kuk and Janssen 2011; Kakarontzas et al. 2014; Al-Hader et al. 2009) suggest a structure that consists of the following components (Fig. 2.9):

(1) *Smart City Networking Infrastructure and Communications Protocol*: addresses the necessary network infrastructure (telecommunications networks and IoT) to deploy smart services and enhance living inside the city.

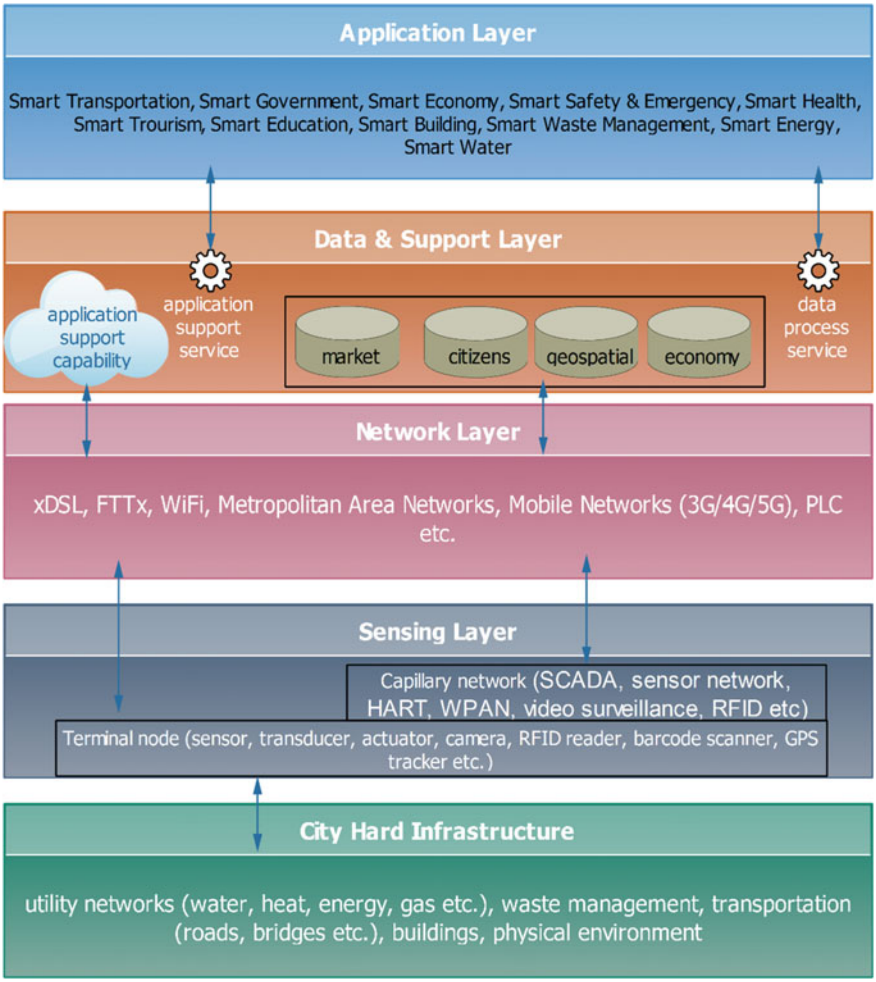


Fig. 2.8 Multi-tier architecture from communications view

(2) *Applications*: concerns all the smart applications, which are available inside the smart city ecosystem. These applications could be classified in the 6 smart city components (people, mobility, government, economy, environment and living).

(3) *Business*: it refers all business groups, which are available inside the smart city ecosystem and use smart applications. This particular module deals with the following information management issues:

- User information for consumer behavior's recognition.
- Business intelligence for statistical and feasibility studies.

Fig. 2.9 Smart city modular architecture

- Industry information for market demand monitoring.
- Business information for commercial and financial analysis.
- Revenue Information for market cash flow and daily business activities' realization.
- Circulation Information for emerged business cases' estimation.

(4) *Management*: contains all rules and procedures for managing a smart city. The primary elements of this module concern:

- Information management: information collection and dissemination across the smart city.
- Process management: ICT management from a business transaction perspective.
- People management: human and workflow management in terms of a sequence of operations within the city, like a single organization and visualization.
- Land/spatial management: urban and rural planning processes, as a means to secure sustainable land use.
- Resource management: resource utilization (e.g., machines, vehicles etc.).

(5) *Data*: data is crucial in smart cities and can be either used or produced, while they can be stored centrally or in a distributed manner (locally). It is analyzed in the following components:

- People data: individual information, which is produced by inhabitants and are mostly preserved with privacy issues.
- Process data: It is produced during smart service execution and routine transactions between machines and/or people.
- Documents: These are mainly used or produced by government applications or within the business sectors. Documents can be also the basis of smart service controls (e.g., quality assurance, disaster recovery plans, etc.) and can be organized in digital repositories.
- Geospatial: used and stored by Geographical Information Systems (GIS).
- Business data: created in the business module and by smart economy applications.

Finally, with regard to the architecture guidelines, these have to satisfy the following aspects:

- Security and Privacy requirements.
- Quality requirements: the minimum set of quality requirements for each architecture's subsystem and for the overall architecture performance. A set of principles for the smart city architecture was presented above, some of which are totally quality-based (e.g., manageability, fault-tolerance, scalability, etc.)
- Guides for each subsystem: most of the above modules can be standardized.

Indicative details regarding these requirements and guides are given by corresponding standards (e.g., ITU 2014b).

2.6 Conclusions

This chapter attempted to explain the smart city context. It explained the corresponding terms from works coming from both literature and industrial standards and defined the smart city with the corresponding outcomes. In brief, this "umbrella" definition concerns *a combination of innovation and ICT within the urban space, as a means to deal with specific challenges*. Several scholars have conceptualized the smart city with different perspectives, which complicate the smart city nexus and in this regard, existing works were compared and combined to return a unified conceptualization smart city framework that collects all existing theory and experience.

Moreover, this chapter presented how the smart city evolved in time. This evolution was neither easy nor clear. Several smart city types have been grounded, they have attracted many city cases since their initial appearance in literature (1997) and either evolved or declined. These smart city types were differentiated according to the technology that was used as the basis for city ICT innovation and evidence show that *eco city* is the most preferred technological type. Finally, an emphasis on smart city ecosystem returns useful smart city architectures, which differ according to the preferred view. In this respect, the architecture framework is useful to support smart city owners and leaders in developing the appropriate solution for their city, while smart city vendors can deploy their products within the corresponding architecture, specifications and guides.

Nevertheless, smart city is an emerging domain and new models for their evolution appear like *Sharing Cities* (Ishida 2017), where sharing economic models (i.e. Uber and Airbnb) are utilized and local resources are being commercialized, while local capital is socialized in order for the cities to sustain in economic and environmental terms. In this regard, all the above analysis generates a collected "snapshot" of findings coming from the timeframe of 20 years of smart city evolution (1994–2016) and normally, new smart city types—accompanied by novel definitions and technologies—are expected to appear in the future.

Revision Question 1:	which were the initial smart city types?
Revision Question 2:	what does technological embeddedness mean?
Revision Question 3:	what is the purpose of a smart city conceptualization model?
Revision Question 4:	which groups of conceptualization models exist?
Revision Question 5:	which are the 8 smart city components? Explain them.
Revision Question 6:	what is the definition of an ecosystem?
Revision Question 7:	what are the elements that structure an ecosystem?
Revision Question 8:	what is the self-congratulatory tendency?
Revision Question 9:	what is the purpose of the smart city coalitions/groups? Can you name 2 of them together with their scope?
Revision Question 10:	which are the city classification methods and their classes?
Revision Question 11:	how have smart cities evolved? Are there any change patterns? What is the source of this evolution?
Revision Question 12:	describe the smart city architecture development process.
Revision Question 13:	which are the smart city stakeholders?
Revision Question 14:	choose and describe the structure of a smart city architecture.
Revision Question 15:	what are the aspects that the architecture guides must satisfy?

References

Alcatel-Lucent Market and Consumer Insight Team. (2012). Getting smart about smart cities understanding the market opportunity in the cities of tomorrow. Retrieved August 2016 from http://www.tmcnet.com/tmc/whitepapers/documents/whitepapers/2013/7943-alcatel-lucent-getting-smart-smart-cities-recommendations-smart.pdf

Albino, V., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology, 22*(1), 3–21.

Al-Hader, M., Rodzi, A., Sharif, A. R., & Ahmad, N. (2009). Smart city components architecture. In *The Proceedings of International Conference on Computational Intelligence, Modelling and Simulation*, IEEE.

Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities, 41,* S3–S11.

Anthopoulos, L. (2015a). Defining smart city architecture for sustainability. In *The Proceedings of the 14th IFIP Electronic Government (EGOV) and 7th Electronic Participation (ePart) Conference 2015*, Thessaloniki, Greece.

Anthopoulos, L. (2015b). Understanding the smart city domain: A literature review. In M. P. Bolivar (Ed.), *Transforming city governments for successful smart cities*. *Public administration and information technology series* (Vol. 3). New York: Springer Science +Business Media.

Anthopoulos, L., & Fitsilis, P. (2013). Using classification and roadmapping techniques for smart city viability's realization. *Electronic Journal of e-Government, 11*(1), 326–336.

Anthopoulos, L., & Fitsilis, P. (2014). Smart cities and their roles in city competition: A classification. *International Journal of Electronic Government Research (IJEGR), 10*(1), 67–81.

Anthopoulos, L., Janssen, M., & Weerakkody, V. (2016). A Unified Smart City Model (USCM) for smart city conceptualization and benchmarking. *International Journal of e-Government Research, 12*(2), 76–92.

Anthopoulos, L., & Reddick, Ch. (2015). Understanding electronic government research and smart city. *Information Polity, 21*(1), 99–117. doi:10.3233/IP-150371.

Anttiroiko, A.-V., Valkama, P., & Bailey, S. J. (2014). Smart cities in the new service economy: Building platforms for smart services. *Artificial Intelligence and Society, 29,* 323–334.

Baron, M. (2012). Do we need smart cities for resilience? *Journal of Economics and Management, 10,* 32–46.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., et al. (2012). Smart cities of the future. *European Physical Journal Special Topics, 214,* 481–518.

Bellini, P., Benigni, M., Billero, R., Nesi, P., & Rauch, N. (2014). Km4City ontology building vs data harvesting and cleaning for smart-city services. *Journal of Visual Languages and Computing, 25*(6), 827–839.

British Standards Institute (BSI). (2014). PAS 180 Smart City Framework Standard. Retrieved July 2016 from http://www.bsigroup.com/en-GB/smart-cities/Smart-Cities-Standards-and-Publication/PAS-180-smart-cities-terminology/

Calvillo, C. F., Sánchez-Miralles, A., & Villar, J. (2016). Energy management and planning in smart cities. *Renewable and Sustainable Energy Reviews, 55,* 273–287.

Cellary, W. (2013). Smart governance for smart industries. *The Proceedings of the 7th International Conference on Theory and Practice of Electronic Governance (ICEGOV '13), October 22–25 2013* (pp. 91–93). Seoul: Republic of Korea.

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J.R., Mellouli, S., Nahon, K., et al. (2012). Understanding smart cities: An Integrative Framework. In *The Proceedings of the 45th Hawaii International Conference on System Sciences (HICSS)* (pp. 2289–2297).

Cocchia, A. (2014). Smart and digital city: A systematic literature review. In R. P. Dameri & C. Rosenthal-Sabroux (Eds.), *Smart city, how to create public and economic value with high technology in urban space*. U.S.: Springer.

Cruickshank, P. (2011). SCRAN: The network. *Journal of Urban Technology*, *18*(2), 83–97.

Desouza, K. C., & Flanery, T. H. (2013). Designing, planning, and managing resilient cities: A conceptual framework. *Cities, 35,* 88–89.

Edvinsson, L. (2006). Aspects on the city as a knowledge tool. *Journal of Knowledge Management, 10*(5), 6–13. doi:10.1108/13673270610691134.

Fan, M., Sun, J., Zhou, B., & Chen, M. (2016). The smart health initiative in China: The case of wuhan, hubei province. *Journal of Medical Systems, 40*(62), 4–17.

Giffinger, R. C., Fertner, H., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. (2007). *Smart cities: Ranking of European medium-sized cities*. Retrieved May 2016 from http://www.smart-cities.eu/download/smart_cities_final_report.pdf

Gil-Garcia, J., Ramon, J. Zhang, & Puron-Cid, G. (2016). Conceptualizing smartness in government: An integrative and multi-dimensional view. *Government Information Quarterly, forthcoming*. doi:10.1016/j.giq.2016.03.002.

Gil-Garcia, J. R., Pardo, T. A., & Nam, T. (2015). What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization. *Information Polity, 20*(1), 61–87.

Gil-Garcia, J., Ramon, N. Helbig, & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government Information Quarterly, 31*(S1), I1–I8.

Glebova, I. S., Yasnitskaya, Y. S., & Maklakova, N. V. (2014). Assessment of cities in Russia according to the concept of "Smart City" in the context of the application of information and communication technologies. *Mediterranean Journal of Social Sciences, 5*(18), 55–60.

Graham, S., & Aurigi, A. (1997). Urbanising cyberspace? *City, 2*(7), 18–39.

Gretzel, U., Werthner, H., Koo, C., & Lamsfus, C. (2015). Conceptual foundations for understanding smart tourism ecosystems. *Computers in Human Behavior, 50,* 558–563.

Hancke, G. P., de Carvalho e Silva, B., & Hancke, G. P., Jr. (2013). The role of advanced sensing in smart cities. *Sensors, 13,* 393–425.

Hollands, R. (2008). Will the real smart city stand up? Creative, progressive, or just entrepreneurial? *City, 12*(3), 302–320.

International Standards Organization (ISO). (2016). *Sustainable development in communities*. Retrieved August 2016 from http://www.iso.org/iso/iso_37101_sustainable_development_in_communities.pdf

International Standards Organization (ISO). (2014a). *ISO 37120:2014: Sustainable development of communities—indicators for city services and quality of life*. Retrieved August 2016 from https://share.ansi.org/ANSI%20Network%20on%20Smart%20and%20Sustainable%20Cities/ISO%2B37120-2014_preview_final_v2.pdf

International Standards Organization (ISO). (2014b). *Smart cities Preliminary Report 2014*. Retrieved May 2016 from http://www.iso.org/iso/smart_cities_report-jtc1.pdf

International Telecommunications Union (ITU). (2014a). *Smart sustainable cities: An analysis of definitions*. Retrieved May 2016 from www.itu.int/en/ITU-T/focusgroups/ssc/Documents/Approved_Deliverables/TR-Definitions.docx

International Telecommunications Union (ITU) (2014b). *Setting the framework for an ICT architecture of a smart sustainable city*. Retrieved May 2016 from http://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/website/web-fg-ssc-0345-r5-ssc_architecture.docx

Ishida, T. (2017). Digital city, smart city and beyond. In *The Proceedings of the 26th World Wide Web International Conference (WWW17), Perth, Australia*. doi:http://dx.doi.org/10.1145/12345.67890

Kakarontzas, G., Anthopoulos, L., Chatzakou, D., & Vakali, A. (2014). A conceptual enterprise architecture framework for smart cities: A survey based approach. In *The Proceedings of the ICE-B 2014—International Conference on e-Business*, *Part of the 11th International Joint Conference on e-Business and Telecommunications*, Vienna, Austria.

Komninos, N. (2002). *Intelligent cities: Innovation, knowledge systems and digital spaces* (1st ed.). London: Routledge.

Kuk, G., & Janssen, M. (2011). The business models and information architectures of smart cities. *Journal of Urban Technology, 18*(2), 39–52.

Lee, J. H., Hancock, M. G., & Hu, M.-C. (2014). Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. *Technological Forecasting and Social Change, 89,* 80–99.

Lee, J.-H., Phaal, R., & Lee, S.-H. (2013). An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change, 80,* 286–306.

Leydesdorff, L., & Deakin, M. (2011). The triple-helix model of smart cities: A neo-evolutionary perspective. *Journal of Urban Technology, 18*(2), 53–63.

Li, Y. R., Wang, L. H., & Hong, C. F. (2009). Extracting the significant-rare keywords for patent analysis. *Expert Systems with Applications, 36,* 5200–5204.

Liu, Y., Wei, J., & Rodriguez, A. F. C. (2014). Development of a strategic value assessment model for smart city. *International Journal of Mobile Communications, 12*(4), 346–359.

Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. *Innovation, 25*(2), 137–149.

Maheshwari, D., & Janssen, M. (2014). Reconceptualizing measuring, benchmarking for improving interoperability in smart ecosystems: The effect of ubiquitous data and crowdsourcing. *Government Information Quarterly, 31,* S84–S92.

McGovern, J., Ambler, S. W., Stevens, M. E., Linn, J., Sharan, V., & Jo, E. K. (2003). *A practical guide to enterprise architecture*. Prentice Hall PTR.

Meijer, A., & Rodríguez Bolívar, M. P. (2016). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences, 82*(2), 392–408.

Naphade, M., Banavar, G., Harrison, C., Paraszczak, J., & Morris, R. (2011). Smarter cities and their innovation challenges. *IEEE Computer, 44*(6), 32–39.

Neirotti, P., De Marco, A., Cagliano, A. C., & Mangano, G. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities, 38,* 25–36.

Perks, C., & Beveridge, T. (2003). *Guide to enterprise IT architecture*. New York, Inc: Springer-Verlag.

Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart cities and the future internet: towards cooperation frameworks for open innovation, the future internet. *Lecture Notes in Computer Science, 6656,* 431–446.

Shapiro, J. M. (2006). Smart cities: Quality of life, productivity, and the growth effects of human capital. *The Review of Economics and Statistics, 88*(2), 324–335.

Shwayri, S. T. (2013). A model Korean ubiquitous eco-city? the politics of making Songdo. *Journal of Urban Technology, 20*(1), 39–55.

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307–320.

Thite, M. (2011). Smart cities: implications of urban planning for human resource development. *Human Resource Development International, 14*(5), 623–631. doi:10.1080/13678868.2011.618349.

Tsolakis, N., & Anthopoulos, L. (2015). Ecocities: An integrated system dynamics framework and a concise research taxonomy. *Sustainable Cities and Society, 17,* 1–14.

United Nations (UN) Habitat. (2014). *Urban Governance Index (UGI): A tool to measure progress in achieving good urban governanc*e. Retrieved May 2016 from http://mirror.unhabitat.org/downloads/docs/2232_80907_UGIndex.doc

United Nations. (2005). *Demographic yearbook 2005*. Retrieved May 2016 from http://unstats.un.org/unsd/demographic/sconcerns/densurb/Defintion_of%20Urban.pdf

van Bastelaer, B. (1998). Digital cities and transferability of results. In *The Proceedings of the 4th EDC conference on digital cities*, Salzburg, pp. 61–70.

van den Besselaar, P., & Beckers, D. (1998). Demographics and sociographics of the digital city. In T. Ishida (Ed.) *Community computing & support systems*. *Lecture Notes in Computer Science* (LNCS) (Vol. 1519), pp. 108–124.

Yigitcanlar, T., & Lee, S. H. (2014). Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax? *Technological Forecasting and Social Change, 89,* 100–114.

Yigitcanlar, T., O'Connor, K., & Westerman, C. (2008). The making of knowledge cities: Melbourne's knowledge-based urban development experience. *Cities, 25,* 63–72.

Yovanof, G. S., & Hazapis, G. N. (2009). An architectural framework and enablingwireless technologies for digital cities & intelligent urban environments. *Wireless Personal Communications, 49,* 445–463.

Zygiaris, S. (2012). Smart city reference model: Assisting planners to conceptualize the building of smart city innovation ecosystems. *Journal of the Knowledge Economy*. doi:10.1007/s13132-012-0089-4.

Chapter 3
The Smart City in Practice

After reading this chapter, you will be able to answer the following questions:

– *What types of technologies synthesize the smart city?*
– *What types of smart services are being offered in practice?*
– *What do competitive smart city standards define for the above smart solutions?*
– *What is the difference between theory and practice regarding smart city?*

3.1 Smart Technologies

In the previous chapter, it has been realized that smart city concerns urban innovation not necessarily but mainly based on ICT. This kind of innovation structures the smart city ecosystem, which was presented as a multi-tier scheme (Fig. 2.7). This figure indicates the different types of hard and soft technologies that are being built by the smart city industry and can be classified as in the following subsections. In each of the following sub-sections a brief presentation and discussion is performed for these technologies and the reader must seek for further details to explore them deeper. This presentation is a today's "snapshot" of smart city emerging and adopting technologies (Lee et al. 2013), while others that are not presented in this chapter are also being progressively embedded in the city (e.g., gamification, augmented reality, city visualization etc.). This section follows the meta-architecture that was extracted in the previous chapter (Fig. 2.7) and the identified smart services.

3.1.1 Smart Water

This technological sector generates solutions for water quality monitoring, water management, remote billing, flood disaster prediction and control etc. Moreover,

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_3

smart water addresses the effects of climate change (e.g., flood disaster generation and corresponding response management etc.). Water related effects are also labeled as "Water Security" by the Organization of Economic Cooperation and Development (OECD) (2013), whereas water management concerns the reduction or avoidance of the four following threats:

- Risk of shortage (including droughts): lack of sufficient water to meet demand;
- Risk of inadequate quality: inappropriate water quality for a particular purpose or use;
- Risk of excess (including floods): overflow of the normal confines of a water system (natural or built), or the destructive accumulation of water over areas that are not normally submerged;
- Risk of undermining the resilience of freshwater systems: exceeding the coping capacity of the surface and groundwater tanks, which can cause irreversible damage to the system's hydraulic and biological functions.

OECD (2013) considers corresponding policy making as a risk transfer process, which has to identify the areas of high risk, while simultaneously has to respect the generation of threats to other areas or ecosystems. The cost of water insecurity to society illustrates the magnitude of these risks, while policy inaction against water insecurity may impact global community markets. Some primary actions that OECD (2013) mentions concerns supply and demand management; monitoring and information collection from water resources with regard to the above threats; targeting the risks with the definition of acceptable levels; and managing water risks (e.g., flood response management).

Traditionally, the water cycle (resource allocation, collection, distribution, consumption as well as collection and treatment of waste water) plays a vital role on urban community existence and affects all the six smart city dimensions and the entire ecosystem (housing, health, economic development, tourism, recreation, transport, waste management and energy) (ITU 2014a, b, c, d). ITU is one of the standardization bodies that address the above OECD risks with appropriate water service utilities, accompanied by technology:

- **Raw water service**: raw water diversion (e.g., from rivers) to cover community needs. Retail water price may include diversion project costs.
- **Water supply services**: collection, treatment and distribution of water that meets the appropriate quality standards to various sectors within the urban environment, including the residential, commercial, and industrial sectors.
- **Drainage services**: with the use of pipe networks that ensure public health and prevent flooding. Some cities have separated their drainage network operation as a type of commercial service by an open bid for franchise of drainage service.
- **Wastewater treatment services**: it addresses commercial/marketed services and it is necessary to ensure environmental protection.
- **Reclaimed water service**: sewage treatment to cover industrial (e.g., power plants) or irrigation needs.

- **Other water supply services**: an indicative alternative concerns sea-water desalination, which concerns a new market with companies that transit from an engineering, procurement, and construction (EPC) equipment provision to an integral investment and operational service.

Urban water management must first ensure access to water and sanitation infrastructure and services, manage rain, waste and storm water, beyond dealing with water risks. Water management has to establish a balance between economic development and water sustainability and it becomes complicated due to climate change's effects (e.g., sea level rise, water scarcity) and to the vulnerability of water distribution facility's aging. In this respect, **smart water management (SWM)** aims to promote a sustainable, well-coordinated development and management of water resources through the integration of ICT products, tools and solutions that equip the cities with technology to deal with water risks, to enhance water management and consumption, and to mitigate the impacts of climate change (ITU 2014a, b, c, d). SWM technology can be classified as follows (Fig. 3.1):

1. **Data acquisition and integration** (e.g., sensor networks, smart pipes, smart meters etc.): smart pipes contain several sensors that can measure strain, temperature and pressure changes, as well as water flow and quality. Sensors enable integration and automation with computer technologies, as well as expansion, since they are connected through smart sensor interfaces like IEEE 1451 standard, with reliable wired and/or wireless network technologies (e.g., Wi-Fi, ZigBee, International Society of Automation (ISA100), mobile networks etc.). Smart meters are electronic devices with advanced metering infrastructure (AMI) that supports on-line measuring of electric power, heat, gas, and water consumption and data transmission via GSM/GPRS or equivalent.
2. **Data dissemination**: it is established with several solutions (e.g., radio transmitters, wireless fidelity (Wi-Fi), the Internet etc.), which enable remote data reading from sensors and meters and transmission to a central system usually hold by the water service provider.
3. **Modelling and analytics**: it is performed with the use of alternative systems (e.g., geographic information system (GIS), Mike Urban water modelling software, Aquacycle balance model, assessing and improving sustainability of urban water resources and systems (AISUWRS), and urban groundwater (UGROW) etc.).
4. **Data processing and storage**: it is enabled with the use of alternative tools (e.g., software as a service (SaaS) and cloud computing etc.). Cloud computing uses external—beyond user's—infrastructure and supports software execution and increase's water provider's capacity with computer modeling and data storage.
3. **Management and control**: supervisory control and data acquisition (SCADA) is a system accompanied by communications tools (e.g., wired, wireless or telemetry), which when it is integrated with water management systems allows water treatment's and distribution's monitoring and control.

3. **Visualization and decision support**: web-based online monitoring systems offer integrated data reporting and visualization from heterogeneous data sources that enhances water provider's decision support processes.
3. **Restitution of data and information** to city technical services and to end users (e.g., information sharing on water and on services): water open data is such an option.

Representative large scale SWM solutions concern the EU UrbanWater project[1] and the Australian Water Resources Information System (AWRIS).[2] An indicative sewage and water level monitoring cases is Holon municipality (Israel), which installed the Solid Applied Technologies (SolidAT)[3] in its sewer systems. Moreover, an indicative SCADA use is being performed in the case of Delft-FEWS and Hollandse Delta Regional Water Authority (Netherlands). On the other hand, representative urban flood management systems are used in Bordeaux (CUB) and Paris (SIAAP), where the INFLUX[4]—a predictive and dynamic management system—has been installed and provides the operators with a complete view of the sewage systems with estimations of their behavior regarding the next 24 h in dry weather and 6 h in wet weather, based on validated meteorological data.

3.1.2 Smart Energy

This class of technologies concern artificial lighting, smart grids, energy efficiency's management, etc. Understanding city's energy efficiency is not an easy process. Cambridge Dictionary[5] defines efficiency as the *good use of time and energy in a way that does not waste any of them*. This definition relates efficiency with productivity or performance and in this regard, energy efficiency within a city could be defined as *the optimal energy use*. However, efficiency is also related with "sufficiency" and in terms of sustainability it concerns the optimal energy use with respect to future generations. Thus, energy efficiency concerns energy use performance, which is a win-win opportunity, since "*through aggressive energy conservation policies, we can both save money and reduce negative externalities associated with energy use*" (Allcott and Greenstone 2012). Allcott and Greenstone (2012) discussed the main energy consumption sources (industrial, transport, residential and commercial) and the primary energy efficiency policies in the U.S.A., which are seen as the encouragement of investments on energy efficient technologies that do not affect energy prices.

[1]http://urbanwater-ict.eu/the-solution-2/.

[2]http://www.bom.gov.au/water/about/wip/awris.shtml.

[3]http://solidat.com/.

[4]http://www.suez-environnement.com/innovation/our-innovations/innovations-access/influx-stormwater-management/.

[5]http://dictionary.cambridge.org/dictionary/english/efficiency.

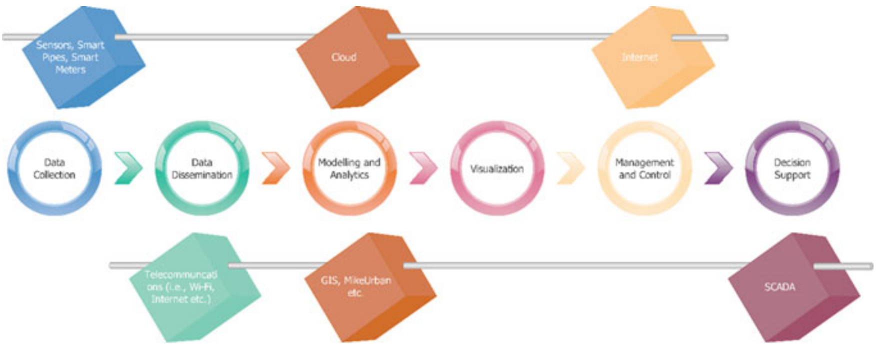


Fig. 3.1 SWM tools assigned to the water management process

Tsolakis and Anthopoulos (2015) questioned smart city (mainly the eco city) performance and used literature findings and System Dynamics (SD) to define a model that realizes the connections between energy demand and supply, and emission producers within a city. In their model, the main energy demand sources concern the local economic players (*service* and *industry* sectors), accompanied by *buildings*, while consumption is measured with quantitative indexes (total consumption and consumption per capita).

Energy and the city are strongly interrelated, since cities by their definition are a focal point of energy consumption (Steemers 2003). Findings from this work agree to the previously presented model, since buildings, transportation and industry are the main energy users, while energy consumption affects local microclimate. Moreover, energy demand highly depends on city's density: dense compared to sparse cities have lower transport and higher buildings' energy demands and vice versa (Steemers 2003). On the other hand, government policies can easily affect transportation (e.g., car change motives) (Breheny 1995; Steemers 2003) compared to measures for buildings' upgrades. A careful look on buildings' energy demands shows that the main proportion concerns heating/cooling purposes, while water heating follows in houses, and lighting in offices (Steemers 2003).

However, city's energy efficiency cannot be seen alone with consumption demands. Hu and Wang (2006) for instance, argue that energy has to be seen with other inputs and corresponding outputs, instead of a single, isolated parameter. They introduce a model [the total-factor energy efficiency (TFEE)] that correlates sustainable growth with energy efficiency and can be utilized for energy efficiency realization. This model uses local labor size, capital, farm area and energy use as inputs and local Gross Domestic Product (GDP) as the output. In this respect, energy demands come mainly from economic forces (industry and farming), which contribute to local economic growth and the adopted technology by the enterprises (state-of-the-art or outdated) plays significant role to energy efficiency. Homma and Hu (2008) utilized TFEE in Japan and discovered an interrelation between energy efficiency and per-capita income.

Another factor that plays significant role in city energy efficiency concerns urban waste management. Cherubini et al. (2008) analyzed several scenarios in Rome, Italy, in attempt to minimize the unused material fraction to be delivered to the landfill, with an energy and emission produce balance. Results showed that landfill activities concern the worst waste management strategy, while waste treatments—with energy and material recovery—allow important benefits of greenhouse gas emission reduction and a significant energy output. Otterpohl et al. (1997) recognize the role of energy efficiency in water pumping, process and delivery in the urban space as another factor beyond the waste management process.

Finally, some other factors are being investigated quite recently regarding their contribution to city's energy efficiency: telecom optical networks (Zhang et al. 2010) and wireless networks (Sankarasubramaniam et al. 2003). Metro-networks are the parts of a telecom network that typically cover metropolitan regions and serve residential subscribers. Data show that increasing the length of these networks, energy consumption is being radically increased (Zhang et al. 2010). In this regard, information and communications technologies (ICT) for energy efficiency and corresponding green computing policies have to be respected too.

On the other hand, Radulovic et al. (2011) investigate policy measures with strong environmental impact and financial feasibility. Their study returns useful findings: they see the interconnection of energy and emission control; the role of energy and gas distribution networks' utility operators; the potential of cities in the emissions trading economy; and that public lighting, urban transportation or public building energy are the sources of corresponding local governments' policy making. In this study, public lighting is recognized as another crucial parameter that influences city's energy efficiency and data from Croatia show significant reduction of emission outputs after public lightings' upgrades.

Similarly, indicative long-term energy efficiency policies can be compared from U.S.A. (Allcott and Greenstone 2012) and in Japan (Kanada et al. 2013) (Table 3.1). Such policies started taking place in 1978 and lasted until 2011 in U.S.A., compared to Japan where they started in 1951 and evolved until 1998. This comparison shows how different energy efficiency can be seen among countries. In U.S.A., a focus is given on capital utilization, while in Japan the focus is shifted to emission control. Both countries defined standards (building codes) for facilities and cars, but Japan was highly influenced by fiscal crises generated by oil prices (oil disasters). Finally, both national policies have been affected by climate change and they shifted towards corresponding measures' definition. The Japanese paradigm is interesting since it shows how the national policy is specialized for Kawasaki city (local policy). More specifically, it shows how interconnected are the policies for emission control and energy efficiency: air pollution policy resulted to energy intensity's reduction, while total energy consumption reduction returned CO_2 mitigation resource efficiency and sustainable development.

The above literature findings show that city's energy efficiency concerns energy utilization and performance—instead of sufficiency—within the urban space and it is highly related with local economic growth and emission control. Moreover, energy efficiency depends highly on the demand sources, which have been

Table 3.1 Comparison of energy efficiency policies in U.S.A. and Japan

U.S.A.		Japan	
Year	Policy	Year	Policy (Kawasaki city specialization)
1978–	Corporate average fuel economy standards	1951	(Threat to public safety recognized)
2006–2010	Federal hybrid vehicle tax credit	1959	(Finance program to treatment facility)
1980–	Gas guzzler tax	1960	Pollution prevention ordinance (the old ordinance)
1990–	Federal appliance energy efficiency standards	1962	Soot and Smoke regulation [national designated area for Soot and Smoke regulation (1963)]
1978–	Residential and commercial building codes	1967	Basic Pollution Prevention Law (loan program for treatment facility installation)
1978–	Electricity demand-side management programs	1968	Air Pollution Prevention Law (the K-value regulation)
1976–	Weatherization assistance program (WAP)	1969	Public Health Compensation Law
2009–2011	2009 economic stimulus Additional WAP funding • Recovery through retrofit • State energy program • Energy efficiency and conservation block grants • Home energy efficiency tax credits • Residential and commercial building initiative • Energy efficient appliance rebate program • Autos cash for clunkers	1970	1st pollution diet (pollution control agreement) Producer's pay principle (finance program for pollution prevention)
		1972	Pollution prevention ordinance (introduction of total emission control)
		1973	1st oil disaster Establishment of pollution-related (pollution-related patient damage relief foundation compensation)
		1976	(Environmental assessment ordinance)
		1979	2nd oil disaster SO_2 target cleared at all monitoring (Energy Conservation Law station)

(continued)

Table 3.1 (continued)

U.S.A.		Japan	
Year	Policy	Year	Policy (Kawasaki city specialization)
			(Basic environmental ordinance)
		1993	Basic Environmental Law Amendment to Energy Conservation Law
		1997	Environmental Assessment Law
		1998	Global Warming Prevention Law Amendment to Energy Conservation Law

classified in buildings (industrial, commercial and residential), businesses and labor size (industry, service and farming sectors), transportation (public and private), public lighting, water and waste management, and recently telecommunication networks. Moreover, efficiency is related to city's density and to the adopted technology (cutting edge versus old-fashioned) by the enterprises. Finally, corresponding policy making is mainly defined at a national scale and it can be specialized at a local level and it can easily affect transportation but it is harder to influence buildings upgrades. Representative policies show that energy efficiency has been highly seen as capital utilization and from a long-term view they influence both economic growth and emission production.

The appropriate process that a city's authority must follow in its attempt to enhance its energy efficiency has been identified by the project InSmart.[6] The project InSmart was started being implemented in the early 2014, it will last until the early 2017 and it is being developed with the contribution of 10 partners coming from 4 countries (UK, Italy, Portugal and Greece). Four (4) representative medium-sized European cities participate in the consortium [Nottingham (UK), Cesena (Italy), Évora (Portugal) and Trikala (Greece)].

This project has multiple objectives, which deal with city energy efficiency and more specifically it aimed to structure a model that can map local energy demand sources; to calculate existing energy efficiency (demand size and performance) in typical medium-sized European cities; and to estimate energy efficiency by 2030 with the simulation of several scenarios that come up from energy efficiency policies being produced at local level. Although some representative energy efficiency policies are demonstrated on Table 3.1, usual local policies are being produced by corresponding national ones or they concern small-scale projects that enhance energy efficiency (e.g., new facility development; public buildings' upgrade; public lighting management systems etc.).

According to the project findings the process to enhance energy efficiency concerns (Fig. 3.2): (a) the determination of the potentially different sources of energy supply and demand in the involved cities; (b) the definition of a reference model (baseline) with energy demand size in the involved cities with the use of data

[6]http://www.insmartenergy.com.

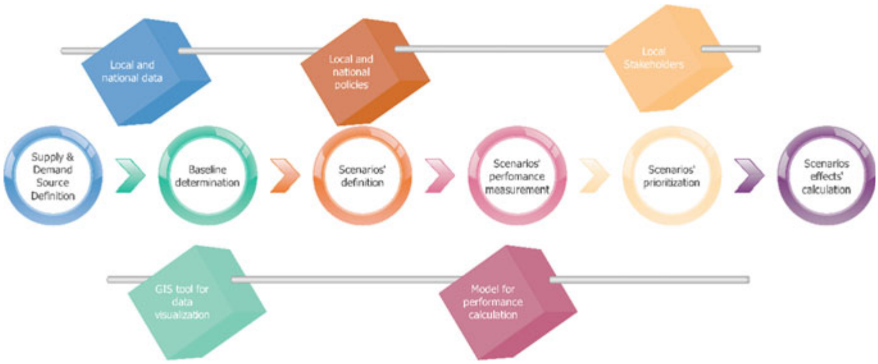


Fig. 3.2 Representative urban energy efficiency enhancement's process

from 2012; (c) the selection of energy efficiency policies (scenarios) from all the involved cities; (d) the development of a model that calculates and estimates energy demand by 2030, according the contributed scenarios; (e) the involvement of city stakeholders in all the city partners in order to define and execute a multi-criteria decision making (MCDM) process for the above scenarios' prioritization; (f) the calculation of scenarios' effect on policy targets. Today, task f is being completed and the outcomes from the involved cities are being compared.

The project InSmart recognized the following energy demand sources for all the involved cities, which satisfy the above literature findings: (a) public lighting (street and open space lighting, fountain operation); (b) water and sewage treatment and distribution; (c) waste chain operation (collection, delivery and processing); (d) buildings (municipal and commercial). Municipal buildings concern the ones that host local government services, as well as the ones that are being maintained by the municipality (e.g., kindergartens). Commercial buildings concern the ones that are being used for retail purposes (e.g., food stores, supermarkets, Non-food stores, and local shops); for offices, industries and warehouses; for education (primary, secondary and tertiary); for leisure (restaurants, hotels, cinemas, leisure centers); and health includes (hospitals and health centers).

All the above findings demonstrate that energy efficiency is both a matter of policy and technology: policy that encourages a shift towards energy efficient solutions' adaptation (e.g., upgraded vehicles and buildings, enhanced fleet management etc.) and technology that supports energy efficiency. When the focus is placed on ICT, then smart grids is the suggested technology that upgrades energy distribution networks with intelligence; smart buildings for buildings; smart water for intelligent water management; and smart transportation for transportation management (ITU 2014b).

With regard to energy supply networks (energy grids), their operation is complex and driven by different needs (ITU 2014b): establish a balance between energy production and consumption; maintain energy frequency's and voltage's stability; protect equipment against overcurrent and short circuits; assure systems' reliability and redundancy (shunt faults, equipment failure with subsequent isolation, switching surges and lightning strikes, mechanical damages), etc. Typical energy grids follow a rather hierarchical structure, which runs from the production sites, through an energy distribution network to the end users. Corresponding telecommunications networks follow the same hierarchical structure: measurements and data flow up from bottom (equipment and metering infrastructures) to higher levels (management centers), while control information is transmitted in the opposite direction. However, communications infrastructure has mainly been deployed in the higher segment of electric networks, typically involving generation plants, high voltage (HV) transport and HV/medium voltage (MV) substations. Such segments have often been served through the use of ad hoc networks (mainly radio relays and in some cases fiber-optic systems) (ITU 2014b).

Smart grids on the other hand (Rawlings et al. 2014), integrate an extensive number of sensors and meters in the distribution segments, distribution energy resources (DER) sites and homes to support demand response, distributed generation and energy-aware applications. This will produce a huge amount of critical information for grid operation to be collected, exchanged and managed in a trustworthy manner, requiring bidirectional flows among different layers. The primary initiatives in such directions concern the deployment of automated meter reading systems at the customers' sites, under the boost of lowering management costs and the push from government institutions. Meters provide a bidirectional communication channel that enables both a control and a metering network. Smart grids enable demand response [based on utilities through Internet broadband communications or through AMI systems (Advanced Metering Infrastructure)]; remote repair for cost savings; support of demand responses according to energy use types; and flexible device control for energy-use reduction during peak consumption periods. Corresponding standards label smart grids (e.g., the *ITU-T G.hnem for smart electrical grid products*) or provide with rules their development [e.g., The Smart Grids Task Force (SGTF) was set up by the European Commission (EC)[7]].

According to their operation, smart grids contain business management systems (network operation monitoring and demand management); information real time processing systems; and micro-grids (smart networks that can be self-managed locally, either connected to—or isolated from—the distribution network) (ITU 2014b).

3.1.3 Smart Transportation

It concerns technologies that enable parking management, intelligent transportation, traffic management, etc. Such technologies are also labeled Intelligent Transportation Systems (ITS) and combine information, telecommunications,

[7]http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm.

positioning and automation technologies in an attempt to improve transportation's safety, efficiency within the urban space and reduce corresponding environmental impact (ITU 2014b, 2007). In this regard, ITS consist of the following components:

1. Vehicles that can be identified, located, assessed and controlled with sensors and/or other equipment;
2. Transportation users who employ ITS (e.g., for navigation, access to trip information etc.);
3. Infrastructure for which the ITS can provide monitoring, detection, response, control, road management and administration functions;
4. Communication networks (wired and wireless) for transactions between vehicles and users.
5. Infrastructure for ticketing both online and onsite (Lee et al. 2014).

ITS enable car-to-car (between vehicles) and car-to-infrastructure (between vehicles and fixed locations) communication, without being limited to road intelligence but supporting rail, air and water transportation (ETSI 2016). Some indicative ITS projects concern (ETSI 2016):

1. **Dedicated Short-Range Communications (DSRC)**: they enable transactions between vehicles and the roadside in specific locations (e.g., toll plazas) and applications such as Electronic Fee Collection (EFC).
2. **Continuous Air Interface Long and Medium range (CALM)**: the aim of the project is to provide continuous transactions between vehicles and the roadside via cellular [Second Generation (2G) mobile (e.g., GSM/GPRS), 3G (IMT-2000 e.g., W-CDMA/CDMA 1x EV-DO) 4G (IMT-Advanced)], 5, 63 GHz and infra-red links. CALM uses DSRC standard, its basic system architecture follows ISO 27217:2010[8] (revised by ISO 27217:2014[9]) standard (ITU 2014b) and it is estimated to provide a range of applications, including vehicle safety and information, entertainment services etc.

The above solutions provide with smart services the public transportation, like corresponding schedule and positioning information services (Pyrga et al. 2008). For instance, an ITS in the smart city of Trikala, provides public transportation vehicles with GSM equipment and prediction algorithms that return buses' arrival and departure times on digital screens located across the main streets of the city (Mizaras 2008; Anthopoulos and Tsoukalas 2006).

All the above projects address some important urban issues that can be resolved with ITS like freight, transit, incident and emergency management (Bertini et al. 2005), with significant benefits in time and cost savings for the city. However, several alternative solutions are being offered, which concern public transportation path optimization, city parking information systems and even car automation Smart

[8]http://www.iso.org/iso/catalogue_detail.htm?csnumber=50507.

[9]http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=61570.

parking systems (Chinrungrueng et al. 2007) provide drivers with information about the availability of parking spaces within a city. The operation of such a system can be based on vehicle detectors on parking entrances; sensors located on the streets that define parking spaces; or even electronic (e-)ticketing systems that collect information about an occupied parking space upon its reservation's payment. Several smart parking systems exist (Chinrungrueng et al. 2007):

- **Parking Guidance Information Systems (PGI)**: they collect information from detectors (loop detectors, machine vision, ultrasonic, infrared, microwave and lasers) and provide parking space information to the drivers to make their choice. Such information ranges from "empty" or "full", to the number of space availability, or to the exact location of available parking slots, are displayed at various spots so that drivers can make better decision.
- **Transit-Based Information Systems**: provides parking space information and public transportation schedules in Park and Ride facilities. Such a system's operation is based on vehicle detectors similar to PGI and aims to encourage the use of public transportation and to reduce traffic congestion, pollution, and fuel consumption.
- **Smart Payment Systems**: they employ advanced payment technologies [contact methods (debit, credit cards), contactless methods (smart cards, RFID cards), and mobile communication devices (mobile phone services)] to replace conventional parking meters. The payment for specific parking space is used to calculate occupied parking spaces.
- **E-parking**: it combines parking reservation and payment systems. Using this system via the Internet or mobile communications, a driver could check the availability, reserve for a parking space at a given destination, and pay when leaving. Car identification is necessary for this system, which is normally based on a confirmation code received on driver's smartphone.
- **Automated Parking**: it is a computer-controlled mechanical system that allows customers to drive their cars into a bay, lock their cars, and let the computer do the rest. To pick up their cars, the customers just punch in their codes and passwords, then the machine will retrieve their cars and ready to leave in just a few minutes. Several vehicle detectors are installed in this system.

Quite recently some more sophisticated or crowd-sensing solutions are proposed for ITS. For instance, Ram et al. (2016) demonstrate a less-expensive ITS that has been installed in the city of Fortaleza in Brazil, which combines GPS bus tracking with an Automatic fare collection (AFC) that stores data about passenger trips. This system (Smartbus) provides with information decision makers regarding public bus route improvements. On the other hand, Farkas et al. (2015) demonstrate a participatory (crowd-)sensing system that collects real-time data from bus passengers via a mobile application (TrafficInfo), which generates vehicle tracking and submits instant route information to the service provider.

3.1.4 Smart Health

This technological set addresses tele-medicine, tele-care and health record management solutions etc. The overall service provision is based on the creation, collection and sharing of the so-called Electronic Patient Records (EPR) (ITU 2014b) or Electronic Health Records (EHR) (Fan et al. 2016). EPR (or EHR) information must be securely available to all public health professionals and clinicians anytime, from anywhere and to any device.

Smart health services are necessary to be offered on a daily basis, especially under emergency conditions (e.g., natural disasters and pandemics) and to distributed, distant locations (e.g., local governments with broad geographic coverage or with several islands). Additionally, the increasing ageing population demands low cost assisted living and health monitoring services, which will enable their independent living at their homes. These types of smart services can be offered with the utilization of sensors and remote devices connected to health operators through broadband, wireless and data analytics, and crucially, the deployment of privacy, identification and security systems (ITU 2014b). Such a tele-care system has been installed in the smart city of Trikala (Anthopoulos and Tsoukalas 2006) and combines wired and wireless communications with distant health monitoring. Today, most of the smart cities across the globe try to implement distant care services in their attempts to support the elderly and communities with chronic diseases (Anthopoulos et al. 2016), which ranks smart health and smart care services as second in existing smart service classification.

Fan et al. (2016) present a multi-tier architecture that delivers smart services within a smart city, which emphasizes data collection, processing and sharing, and consists of the following four layers:

1. Data source layer that contains all health information.
2. Data processing layer, which offers tools for processing data from the data source layer, and putting them into the repository or data warehouse.
3. Data center layer, which is designed for unified data management and sharing with all business applications of the fourth layer of the platform.
4. Data application layer that contains the business application systems, which are used by residents, medical institutions, health administrative departments etc.

Except from the EPR (or EHR) the operation of such a system is based on Internet-of-Things (IoT) (Fan et al. 2016) and Machine-To-Machine (M2M) (ITU 2014b) communications: sensors are located near the patients/customers, which collect and submit data to an M2M platform. A health-care provider utilizes this amount of data to monitor customers' health condition and support them with medical services when it is necessary. Some corresponding use cases that can be handled from a smart health system concerns the following (ITU 2014b):

1. Legacy mass medical examination.
2. Travelling mass medical examination.
3. Remote patient monitoring.
4. Tele-health counseling system.
5. Tele-health management system.
6. Ambient assisted living (AAL).
7. Personal health care data management.
8. Easy clinic.

The above use cases are supported with several remote devices, installed in patients' houses, like e-health equipment; cameras; home sensors; mobile sensors/terminals; emergency buttons; medical supplies with automated functions; and support devices.

3.1.5 Smart Safety and Emergency

This technological set concerns public safety, and disaster prediction and response, while it delivers some of the most important smart city applications (Su et al. 2011). Public safety concerns city services that ensure city safety in terms of environmental conditions, accident and crime avoidance, as well as food and product safety. The smart living dimension (Giffinger et al. 2007) is measured—among others—with individual safety indexes (crime rate, death rate per assault and satisfaction from personal safety).

In this respect, the ICT can contribute with monitoring city conditions (e.g., local environmental conditions; roads and traffic; facilities and perimeter) and with enabling access control (ITU 2014b). Some indicative public safety systems concern (a) an emergency center hosted by the city or the civil protection; (b) Geo-location Systems of Cell Phones; and (c) the System of Local or National Alert (ITU 2014b) (Figs. 3.3, 3.4 and 3.5). Both these systems must be interconnected, while data are collected with sensors and devices (e.g., cameras) across the city and transferred via increased bandwidth networks.

Emergency response management was noted as one of the most important smart city challenges quite early (Hall 2000), when advanced city monitoring systems and built-in sensors collect and process real-time data and enhance decision making during natural or man-made crises. Emphasis on emergency response is given on city critical infrastructure including roads; bridges; tunnels; rail/subways; airports; harbors; communication, water, gas and energy networks; and even major buildings.

Such a disaster response management system provides decision makers with GIS maps, where available resources are located on maps and use-case scenarios manage their optimal use. For example, resources can be committed prior to a water main break, salt spreading crews dispatched only when a specific bridge has icing conditions, and use of inspectors reduced by knowing condition of life of all structures (Hall 2000). However, ICT alone is not enough to ensure city safety and disaster response, but corresponding stakeholders (e.g., fire brigade, health

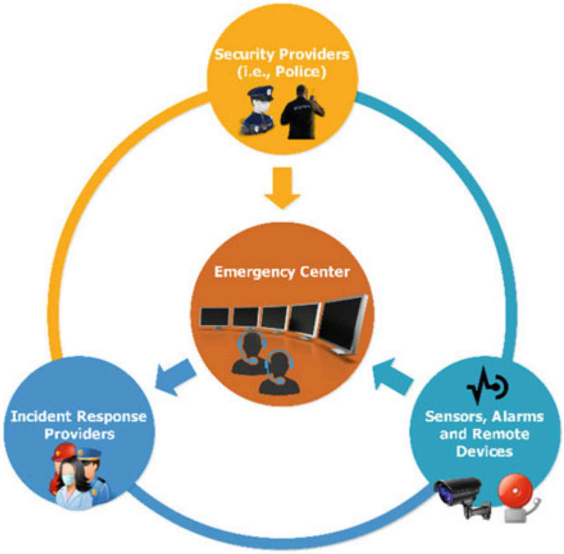


Fig. 3.3 Safety and emergency operating center

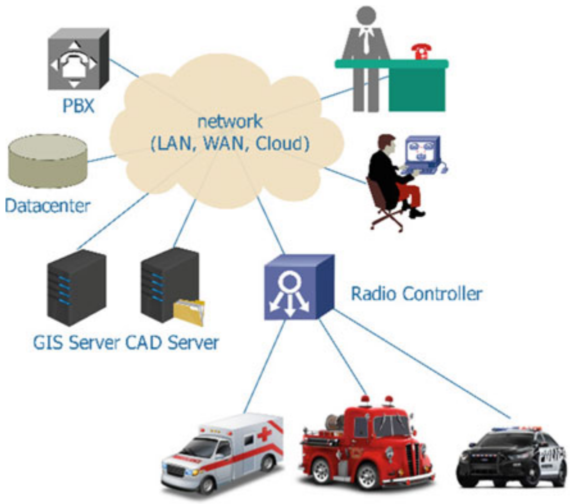


Fig. 3.4 Emergency operating network

organizations and professionals, police, civil protection etc.), must use these systems and follow well documented procedures (use cases).

The ability of a city to respond against crises has been recently labeled as "*sustainability*" or "*resilience*". Both these terms are being adopted by the smart city terminology but they are confusing. A recent study by Lizarralde et al. (2015) tries to shed light to both these terms with the analysis of both literature and policy documents in UK. According to this study, *sustainability* is seen as the ability to grow with a respect to future generations and in this regard, environmental

Fig. 3.5 Emergency response process

protection, economic viability and social cohesion are respected by a sustainable city. On the other hand, *resilience* is seen as the ability to stand against vulnerabilities in the face of natural hazards and man-made threats. Corresponding policies (Lizarralde et al. 2015) define specific objectives for both sustainability and resilience (Table 3.2), which clarify that sustainability focuses on environmental protection, while resilience emphasizes on the adaptation to the environment with corresponding risk estimation and ability to respond. Table 3.2 presents findings from the UK paradigm regarding sustainable and resilient cities.

Table 3.2 Differences between the paradigms and agendas of sustainability and resilience (Lizarralde et al. 2015)

	Sustainability	Resilience
Final goal in the built environment	Achievements in environmental protection	Development of capacities for adaptation to the Environment
Means of implementation	Incremental performances in environmental protection	Trial and error performances in adaptation and recovery
Focus regarding the performance of Systems	System eco-efficiency, seen as the capacity to function with the minimum use of resources	System efficiency, seen as having redundancies that avoid system breakdowns
View of equilibrium between the natural, social and built environment	Mid-term equilibrium defined according to current targets based on scenarios of environmental degradation	Long-term equilibrium defined according to fluctuating (currently unknown) conditions
Specific ways to achieve the agendas	Define standards through certifications	Identify and develop potentials and capacities
Focus of the UK agendas	Floods, reduction in emissions, protection of green zones	Terrorism, recovery after disasters, economic resilience
Frequent terms used in policy in the UK	"Carbon", "climate", "energy", "efficiency", "change", "policy"	"Emergency", "risk", "attack", "security", "guidance", "planning"
Barriers for implementation in the built environment in the UK	Additional costs implied Narrow views of sustainability Interest in protecting economic growth	Institutional disengagement Tendency towards reactive rather than proactive approaches Lack of public awareness Perception of something negative happening

3.1.6 Smart Education and Smart Tourism

Given the fact that one of smart city dimensions is *smart people*, which is measured among others with indexes that evaluate education and lifelong learning, this class concerns the use of ICT to support learning and knowledge sharing. More specifically, the role of education is measured with the following indexes (Giffinger et al. 2007):

1. Level of qualification:
   a. Importance as knowledge center (top research centers, top universities etc.).
   b. Population qualified at levels 5–6 ISCED.
   c. Foreign language skills.
2. Affinity to lifelong learning:
   a. Book loans per resident.
   b. Participation in life-long-learning in %.
   c. Participation in language courses.

The above 6 quantitative indexes show that the existence of knowledge centers and libraries, together with corresponding public interest and social participation play vital role in increasing local community's creativity, social plurality and employment flexibility. Further to the above, education facilities impact *smart living* dimension and their performance is measured by the number of students per inhabitant and by two qualitative indexes (satisfaction from access to the educational system and from quality of the educational system).

In this regard, ICT can enhance both in-class and distant education services, with the consideration of citizen in the center of the educational scenarios (ITU 2014b). Some indicative smart education services concern online learning systems; training by computer; forums and collaboration with experts; information about job opportunities; and meetings that promote retraining etc. Additionally, ICT solutions that enable virtual museums, digital public libraries, augmented reality, digital art, co-creation and other leisure activities, assisted real-time translation and cultural mediation are also members of this class.

Tourism on the other hand, is addressed in the context of smart living dimension (Giffinger et al. 2007) with 2 quantitative indexes under the "umbrella" index labeled "Touristic attractivity", which measure city's importance as tourist location (overnights, sights) and overnights per year per resident. In this regard, this class of smart solutions aim to enhance local touristic capacity (sightseeing, municipalities, commerce, museums, churches and hotels) and visitor's experience (geographic locations, interests, events etc.) and offer city guides, location based services, marketplaces, content sharing, etc. (ITU 2014b). Moreover, the smart city itself affects visitors' arrivals with environmental or technological concerns.

3.1.7 Smart Waste Management

Waste management was already seen as part of city's energy efficiency in terms of corresponding transportation's optimization and emission control. Smart environment dimension (Giffinger et al. 2007) measures existing environmental quality and calculates only emission products (summer smog and particulate matter) in the urban space.

However, waste management concerns the entire waste cycle (deposit, collection, delivery and process) and corresponding technologies enable waste chain monitoring, city waste management, emission control, recycling with the use of ICT, etc. More specifically, the following infrastructure is proposed for smart waste management (ITU 2014b):

- IoT to form a closed-loop management for monitoring, early warning and control of pollution sources.
- Distributed sensors to monitor air quality and urban noise, to communicate these values with the local community and utilize mobile communication systems to strengthen the linkage between the supervision and inspection departments.
- Sensors to monitor water quality in water tanks, rivers and water supply networks.
- Sensors to monitor forests, wetlands and other natural resources, and GIS to visualize green open spaces.
- Sensors to monitor and systems to manage thermal energy and building temperature.
- Sensors to monitor waste depositories fill limits, which optimize collector vehicles routes and schedules, and reduces produced emission.

Beyond the above, the amount of produced waste per citizen is necessary to be monitored and controlled (ITU 2014b) and corresponding ICT solutions use citizen smart cards to access waste repositories and containers (e.g., Groningen city, the Netherlands). Additionally, end-to-end waste management systems (e.g., New Songdo, South Korea) enable remote garbage collection from the buildings via appropriate pipe networks, collection and process at a particular factory, where recycling is performed and compost produces heat water that warms or cools the city apartments.

3.1.8 Smart Buildings

Buildings play the most important role in city's energy efficiency and emission production (Abdellatif and Al-Shamma'a 2015), while smart living dimension is measured—among others—by housing quality (proportion of buildings that fulfill minimal standards; average living area per inhabitant; and satisfaction with personal

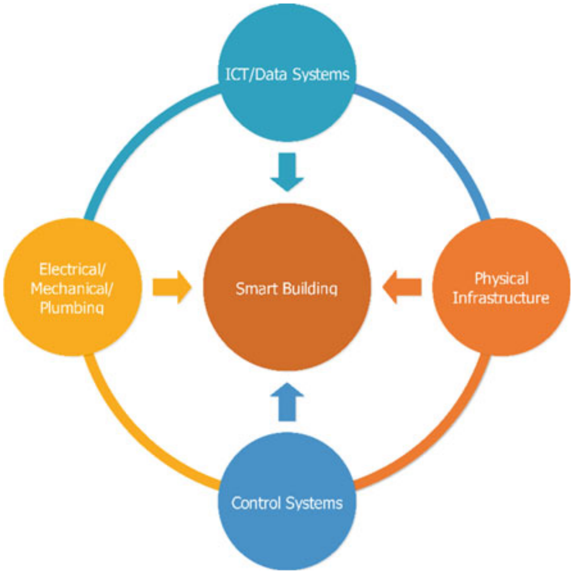


Fig. 3.6 Smart building synthesis

housing situation) (Giffinger et al. 2007). Moreover, household broadband and ICT penetration indexes calculate—among others—smart mobility dimension.

To this end, the label of "smart building" has been introduced, which attracts significant scientific and industrial attention. A smart building is the integration of building, technology, and energy systems, which extend the typical "three utilities" of buildings (electrical, mechanical and plumbing) with the "fourth utility" the ICT (2014c). More specifically, except from physical infrastructure (framework, floor, windows etc.) and its conventional utilities (electrical, mechanical and plumbing), ICT (wired and wireless network equipment) and corresponding control systems (Building Automation and Heating, Ventilating and Air Conditioning (HVAC) Control; Energy Management Systems; Lighting Control Systems, Building Security and Access Control; Video Surveillance Systems; Fire and Safety Systems; Car Parking Systems etc.) (Fig. 3.6) enhance its intelligence (ITU 2014b, c).

According to the above, this class contains technologies that measure and optimize building energy performance (smart meters, demand response); lighting (occupancy sensing); water (smart meters, use and flow sensing); remote monitoring (condition monitoring, parking lot utilization, elevators' performance and maintenance); access and security (badge in, cameras, integration perimeter, doors); and control (fans, variable air volume, air quality and temperature) (ITU 2014b, c).

Moreover, the underlying philosophy of smart buildings concerns that they can constantly monitor current conditions and automatically adjust resources for optimal efficiency while identifying and accurately enable on-time decisions (ITU 2014c). This can range from the routine processes, such as variance to the preventative maintenance schedules, to automated restocking and repairs according to changes in the normal operational patterns. Smart buildings are based on "smart objects", which concern physical infrastructure with embedded equipment (e.g., sensors); devices with remote control capabilities; data and ICT infrastructure; Intelligent Building Management Systems (IBMS); and smart energy control systems (ITU 2014c). An IBMS concerns the kernel of the intelligent building, since it monitors and manages all the individual ICT and control systems.

According to the above, beyond the significant role of ICT fourth utility, important role plays the clear commitment of the building stakeholders (owners, operators and designers) in ensuring the exploitation of smart technologies and their advantages in building's efficiency and safety. Another benefit concerns the impact size that multiple smart buildings can generate by forming a community, a campus, or possibly even a city. For example, a university is such a typical campus facility, which in many cases is monitored and controlled by a central facility and could easily adopt smart building technologies and extend typical security and networking functions to more efficient building operations (ITU 2014c).

Similarly, except from residential buildings and universities, these types of smart technologies can be utilized by commercial buildings, hotels, hospitals and factories. Some indicative smart building services concern the following scenarios: customers of an intelligent mall can have access to the information provided by the embedded technologies and realize whether temperature conditions are the appropriate to ensure food safety; smart hospitals can track patients arriving at the emergency rooms; a factory can monitor air and temperature in order to provide the appropriate manufacturing conditions etc. (ITU 2014c).

Another significant benefit of the intelligent building technologies concerns the contribution of collected information in building's operation and maintenance activities. Unnecessary energy use can be eliminated with the use of technology (e.g., do not heat or cool or light areas when they are not occupied). Moreover, maintenance checks can be performed real time, without the visit of specialists (Table 3.3). The only key is to ensure that sensors are cleaned and calibrated on a regular basis. Poorly performing sensors can be the reason that an intelligent building does not result in operation and maintenance costs' reduction.

Finally, an intelligent building can contribute to city's resilience against climate change with its own resilient performance (Abdellatif and Al-Shamma'a 2015). Natural phenomena (e.g., flood, heat waves, ice storms, cold spells, tornados and hurricanes etc.) result to short and long term impact on building infrastructure (ITU 2014c). Short term events result to structural damages, to utility systems' failures, even to closure and loss of revenue. Long term events degrade building's infrastructure significantly. Measures are demanded to be undertaken that maintain the building's external surface and to prevent damages to its internal framework and equipment. In this regard, the design and the infrastructure of the intelligent building can assist with minimizing the effects of extreme weather conditions (ITU 2014c). The evaluation of a building's intelligence is based on several benchmarks that measure the different sub-systems with recommendations for improvement in multiple categories including communication systems; building automation; annunciation, security and control systems; facility management applications; and building structure and systems (ITU 2014c).

Table 3.3 Indicative typical maintenance procedures supported by smart building (ITU 2014c)

Boiler efficiency measurement. Monitor combustion efficiency, carry out efficiency tests and calibrate burners to meet manufacturer specifications
Cooling systems' control. Adjusted to meet efficiency requirements as well as seasonal and operational needs of the occupants for each day (including holidays), and time-of-day
Temperature and humidity control. Ensure they are set correctly and are responding as intended. There should be twice evaluations per annum
Air supply grilles' checks to ensure they are not blocked and are delivering air as required
Refrigerant leaks' measurements. Refrigerant systems must maintain their charge according to the manufacturer's requirements (e.g., refrigerant leakage below 5%)
Cooling towers' monitoring. Water treatment measurements, bleed control and concentration cycles, water temperature, pump operation and sequencing
Scheduled filter replacement. Replace or clean filters according to manufacturer's recommendations. Ensure correct size and type of filter

3.1.9 Smart Government

This class is analyzed in detail in Chap. 6, where this particular term is usually misunderstood or it is highly interrelated with smart city. Smart government is not only the next step for government evolution with the use of innovation. It concerns a creative mix of emerging technologies and innovation in public sector, where the ICT is utilized for agencies' integration and for service co-creation. Smart city is considered an area for smart government testing and evolution, while smart government is a smart city dimension too. More specifically, smart governance in smart city is measured with indexes (Giffinger et al. 2007) that calculate participation in decision-making (counselors per citizen; inhabitants' political activity; politics' importance; female share in city council); public and social services (municipal expenditure; children care's share; schools' quality); and government transparency (citizen satisfaction against bureaucracy and corruption). With regard to the adopted technology, this class contains solutions that enable public information and service delivery, as well as citizen participation and service co-design.

3.1.10 Smart Economy

There's no clear definition for smart economy. It has been used to label "greater productivity and sustainable jobs" (Government of Ireland 2008), while in the smart city context, it defines the role of smart technologies in local economic transformation; how the smart city becomes an economic driver; and what are the economics behind smart cities (U.C. Berkeley's Department of City and Regional Planning 2012). Smart economy is a smart city dimension, which is measured (Giffinger et al. 2007) by indexes that calculate local innovative spirit (R&D expenditure; employment in knowledge-intensive sectors; and patents); entrepreneurship (self-employment; and new business registration); economic image and trademarks (importance as decision making center); productivity (GDP per employed person); labor market flexibility (unemployment rate; part-time employment); and international embeddedness (companies with their headquarters in the city; and air transport size). All the above information shows that smart economy can be seen as the economic growth with the use of innovation and the ICT, while it deals with economics in the smart city too.

In this respect, this technological class contains information systems that supports economic growth (e.g., e-business for intra-organization and inter-organization services like Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM), online procurement systems, e-banking systems, etc.). Moreover, technologies that enhance economy—e.g., open data and Apps—suggest a driver for local economic growth, while the local digital sector itself encourages corresponding investments and attracts employment too. Finally, smart infrastructure (e.g., ultra-high speed networks) installed in the smart city encourages business relocation and paradigms like Dubai and Kista validate such a phenomenon.

3.1.11 Telecommunication Networks

This class contains networking infrastructure, including cabling, IP Networks, Voice, Video and Wireless or even quantum telecommunications,[10] and corresponding data transmission security solutions, and the entire infrastructure contained in the network layer of Fig. 2.8. The network layer indicates various networks installed in the city by telecommunication operators, as well as other metropolitan networks developed by city stakeholders. It is the "infobahn", the network layer data and support layer. Its main purpose is to ensure the support capabilities of various city-level applications and services (ITU 2014b, c).

The network infrastructure is the transport medium (wired and wireless) that carries all the data: voice, video (multimedia), security, VoIP (voice over IP), PoE (Power over Ethernet) between the communication points, while the Internet Protocol (IP) enables this communication. It forms the backbone via which data travel from one location (transmitter) to another (receiver), while interoperability techniques enable communication between different systems (e.g., intelligent buildings and intelligent transportation). Smart cities must have secure and

[10]http://swissquantum.idquantique.com/.

interoperable data networks that comply with the following requirements (ITU 2014b, c):

- Establish integrated voice, video and data;
- Apply data security measures—including encryption, admission and intrusion detection;
- Establish data quality of service (QoS);
- Enhance bandwidth management;
- Ensure redundancy (in case of failure) including Uninterrupted Power Supply (UPS);
- Enable ICT device management.

Typical technologies that are part of a networking infrastructure include (ITU 2014b, c):

- Wide Area Network (WAN), Local Area Network (LAN), Personal Area Network (PAN), Metropolitan Area Network (MAN) and Storage Area Network (SAN) infrastructure: usually a multi-tier architecture that consists of the access, the distribution and the core layer is followed, which ensures network operation even in cases of partial failures.
- Core Routing Switches: they connect access switches and they provide user connectivity across the entire network and the Internet;
- Access Switches: they are located at the access layer of the architecture and they aggregate traffic (e.g., from desktop, laptop, smartphones, IP phones, and videoconferencing terminals).
- Wireless Networking: Wi-Fi[11] and Wi-Max[12] access points, controllers and antennas enable short and large scale wireless communication.
- Firewalls: they protect servers across the city by malicious attacks (e.g., e-mail spamming, website defacing etc.); they protect the network from Denial of Service (DoS) attacks through incorrect or malformed IP packets; and they protect users from external attacks through incorrect or malformed HTTP data.
- Network Routers: they provide connectivity to local and external Internet Service Providers (ISP).

In general, the communications layer consists of three separate networks (Fig. 3.7) (ITU 2014b):

1. Access network: it is installed in each end-user's environment (business or home) and follows several types of technologies (e.g., Ethernet).
2. Transport Network: it enables data transaction across the city. Several technologies can be combined (e.g., fiber-optics, Dense Wavelength Division Multiplexing (DWDM), Ethernet, Optical + Ethernet and Wavelength Division Multiplexing (WDM), Multiprotocol Label Switching (MPLS), Fiber to the X (FTTx) Access Networks, X Digital Subscriber Line (xDSL), Mobile

[11]http://www.wi-fi.org/.

[12]http://wimaxforum.org/.

Broadband Wireless Access Technologies, 4th Generation of Mobile Broadband Wireless Access Technologies, Millimeter Wave Communication etc.)

3. Backbone: it enables the interconnection of the smart city network with the Internet. Virtual Private Networks (VPN) is an encryption solution that can be used for such a connectivity.

The data center is a centralized repository for smart city data storage, management, and dissemination (ITU 2014b). Data centers must be scalable, redundant and reliable, and must perform smoothly and efficiently in collecting data from an extensive and growing number of sensors across the city. In this regard, the data center must meet the minimum requirements in capacity and computational performance in order to serve the potential business applications and peak day times. Such scalability issues must be analyzed in order to prevent wasting unutilized resources, which generate unnecessary costs from energy consumption and software licenses. A representative data center multi-tier architecture that meets these requirements is demonstrated on (Fig. 3.8) (ITU 2014b), which consists of the following layers:

- Smart service layer: it delivers smart services across the city.
- Business application layer: it contains the applications that run the logic of the smart services.
- Operating systems: the software systems that are demanded to serve the business applications.
- Virtual machines: the define the necessary virtual servers for each of the applications and the corresponding operating systems, offering redundancy, scalability, maintenance and easy monitoring.
- Hypervisors: the servers that host the virtual machines.
- Physical infrastructure: all the necessary hardware to serve the data center (servers, storage, network components, UPS etc.).
- Management layer: it contains a software suite for managing and monitoring the data center.
- Security layer: it contains all the necessary software and hardware equipment to protect the data center against all defined types of vulnerability (e.g., application, data and physical security etc.).
- LDAP catalogues: single sign-on is necessary when several applications and services are being offered by the same stakeholders. This layer contains all necessary Lightweight Directory Access Protocol (LDAP) catalogues for registered architecture components and users.

A data center (ITU 2014b) can occupy one room of a building, one or more floors, or an entire building and follows specific operating standards for air-conditioning, power supply, physical security (e.g., fire suppression and accessibility), backups and monitoring. Horizontal cabling systems, UPS, network and security infrastructure compose the data center and ensure uninterrupted data center's operation

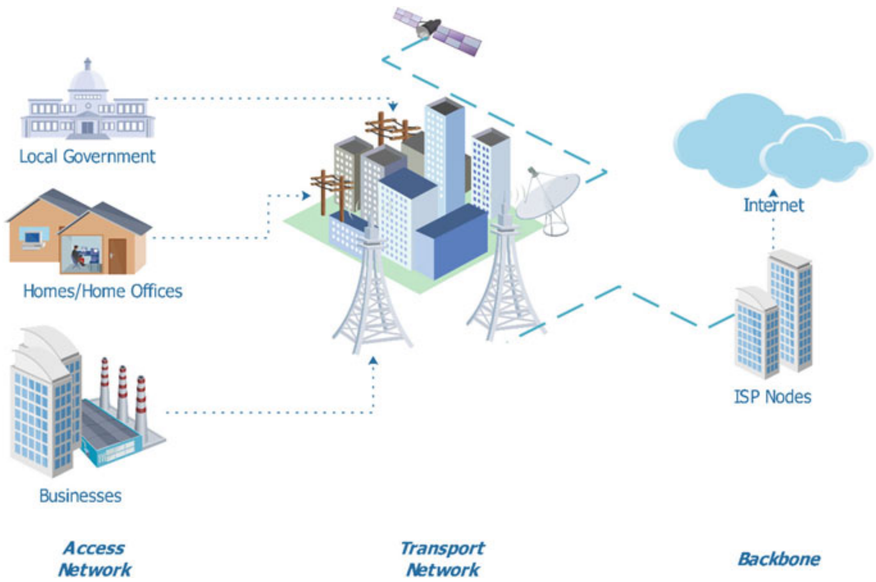


Fig. 3.7 Network types in smart city

against single points of failure and several types of attacks or disasters. Moreover, several standards exist that enhance data center's green operation (e.g., ITU-T L.1300: Best practices for green data centres[13]).

3.1.12 Sensors and Internet-of-Things

It concerns different types of "smart objects" that belong in the sensing layer of (Fig. 2.8), which is analyzed in the terminal node and capillary network. The terminals or gateways (e.g., sensor, transducer, actuator, camera, Radio-frequency identification (RFID[14]) tag, barcode symbols etc.) "sense" and collect data from the natural environment and the corresponding utilities (e.g., water, energy, transport etc.) of the smart city. This infrastructure enhances city's intelligence and enables physical infrastructure's monitoring and controlling. More specifically, the are used to collect information regarding resources, security, lighting, presence, weather, transportation, movement or position and monitor climate, traffic, pollution, entertainment, crime etc. (ITU 2014b, c). On the other hand, the capillary network connects various terminals to communication layer or directly to data layer and/or application layer providing ubiquitous transactions (ITU 2014b, c).

[13]https://www.itu.int/rec/T-REC-L.1300/en.

[14]https://en.wikipedia.org/wiki/Radio-frequency_identification.

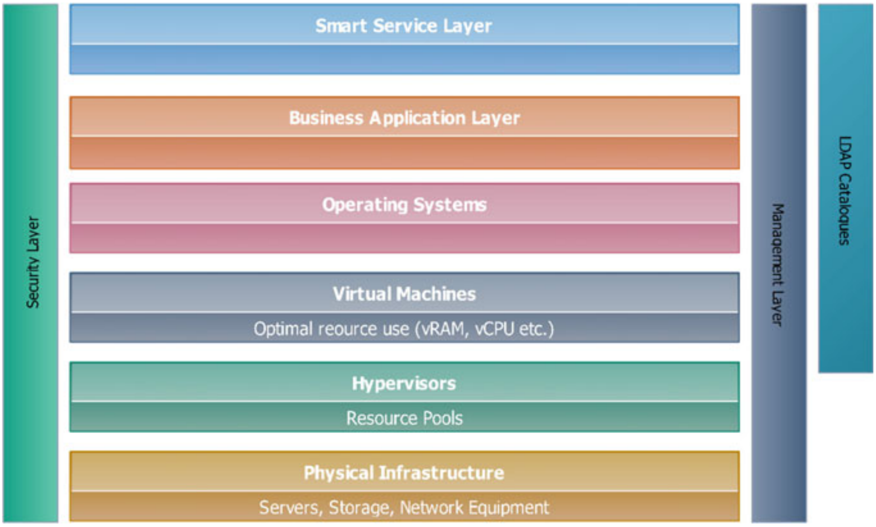


Fig. 3.8 A representative data center architecture

A sensor network combines sensing, computation and communication into a single, tiny device. Mesh (wired and wireless) networks installed the city can interconnect an extensive number of sensors, and the cyberspace with the physical world. Sensors play the role of nodes within these networks and must be designed with means that meet size, cost and power requirements. In order to realize the architecture of a sensor network, application scenarios have to be considered, which concern the following (ITU 2014b):

1. **Data collection and submission to base stations for offline analysis (e.g., for environmental monitoring)**: low data rates and long lifetime characterizes the nodes of this case, while data storage follows traditional methods. The structure of a hierarchical tree is followed, where each child node transmits data to its parent. This structure can generate a "bottleneck" since intermediate nodes submit more data than the leaf nodes, but time intervals (e.g., 1–15 min) do not cause troubles due to the context of the collected data (e.g., temperature and humidity).
2. **Sensor monitoring from fixed locations and abnormality detection (e.g., security monitoring)**: a key difference to the previous scenario is that no data is actually being collected, but instead data is being transmitted by a node only when a change in its condition is being detected. Quality requirements for such a network concern the establishment of immediate (in seconds) and reliable communication of alarm messages between the nodes and the bases, together with the ability of each node to confirm its presence and functioning (e.g., once per hour). In this regard, additional nodes have to be incorporated in the network to check the status of others. In general, energy requirements are low for such a

network and its majority is spent on meeting the strict latency requirements associated with the alarm reports submission when a security violation occurs. Autonomous 3G/4G sensors equipped with video cameras that enable the development of new security, surveillance and military applications are being used, which consist the wireless sensor network platform for the Internet of Things (IoT). This type of sensors uses ZigBee,[15] Bluetooth[16] and Wi-Fi protocols to send low bandwidth data such as temperature, humidity and CO_2 levels, and high speed Wideband Code Division Multiple Access (W-CDMA)[17] and High Speed Packet Access (HSPA)[18] mobile networks to upload video.

3. **Node tracking**: it concerns scenarios where several objects embedded with the appropriate tags (e.g., RFID-based, Quick Response (QR) codes etc.) can be continuously monitored by a sensor network. Current inventory control systems track objects by recording the last checkpoint that an object passed through a sensor network. The nodes of this network sense radio signals, which announce the presence of a device. A database is used to store the location of tracked objects and it becomes possible to request the exact location of the object and not just the last location where it was last scanned.

   There are two primary methods for location tracking when sensor devices are located in a large area such as a city. The most extensive one is to use a GPS module to get the information sent by the satellites and extract all the information possible (latitude, longitude, speed, direction).

   For cases that combine outdoor and indoor tracking (e.g., buildings, tiny roads and tunnels etc.) an alternative method collects the information from mobile phone cells and retrieves location from a previously recorded information, stored in a database. This information can include Cell Identity (ID), Received Signal Strength Indication (RSSI)[19] and Timing Advance (TA)[20] of any of close base stations.
4. **Hybrid networks**: usual scenarios combine some or all the above 3 categories and result to hybrid sensor networks. For example, in case of vehicle tracking, the network may switch between being an alarm monitoring network to a data collection network. During a long period of inactivity when no vehicles are present, the network will simply perform an alarm monitoring function.

Internet of things (IoT) on the other hand, is a widely-used term for a set of technologies, systems, and design principles associated with the emerging wave of Internet-connected things that are based on the physical environment. In this respect, *IoT is a network that consists of all types of devices, sensors and terminals, which use the Internet for their data transactions* (ITU 2014b) or *the*

[15] http://www.zigbee.org/.

[16] https://www.bluetooth.com/.

[17] http://www.3gpp.org/technologies/keywords-acronyms/104-w-cdma.

[18] http://www.gsma.com/aboutus/gsm-technology/hspa.

[19] https://en.wikipedia.org/wiki/Received_signal_strength_indication.

[20] https://en.wikipedia.org/wiki/Timing_advance.

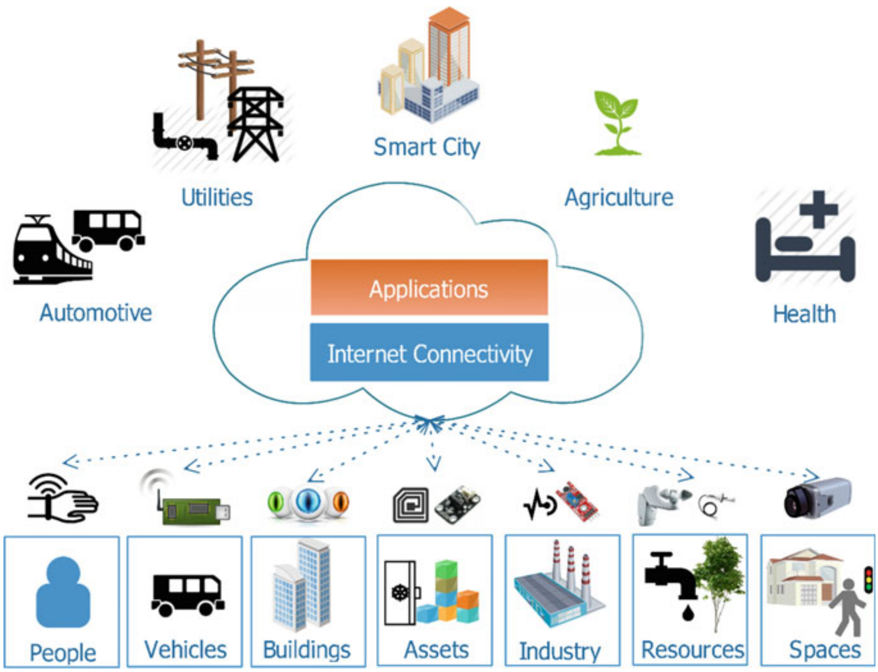


Fig. 3.9 The IoT ecosystem

interconnection of uniquely identifiable embedded computing like devices within the existing Internet infrastructure (ISO 2014b). This definition comes close to the definition of Machine-to-Machine (M2M)[21] communications, which concerns *the connection of sensors and other devices to ICT* via *any communications channel, including wired or wireless networks.* However, IoT refers to the connection of such systems and sensors to the broader Internet, as well as the use of general Internet technologies, which determines that IoT ecosystem will emerge similarly to the Internet and enable their transactions in ways similar to humans' web use (ITU 2014b). This Internet extension to the IoT transforms the existing Internet ecosystem (people, media and content) to a broader environment, where physical objects with embedded intelligence will exchange information, interact with people, support business processes and create knowledge "Anytime, Anyplace, with Anything and Anyone" (Fig. 3.9) (Holler et al. 2014).

The basic IoT devices connected to physical objects are *sensors*—explained earlier; *tags*—used to read information by sensors; and *actuators*—can change an object's state (translate, rotate, stir, inflate, switch on/off etc.). IoT connected devices are estimated to exceed 50 billion by 2020 (CISCO 2013) and structure the "nervous system" of a smart city, since they enable interconnection and information flow

[21] https://en.wikipedia.org/wiki/Machine_to_machine.

between the physical environment, facilities, machines and people. Connectivity between this extensive number of objects obliges developers to proceed to the adoption of the Internet Protocol Version 6 (IPv6)[22] (Patil and Pawar 2016).

Moreover, a direct effect of the IoT is the generation of huge quantities of data (Big Data), where every physical or virtual object connected to the IoT could generate regular updates. As a result, consumer IoT related data volumes could easily reach between 1000 and 10,000 per person per day (ITU 2014b). An IoT architecture -like the smart city's presented in Chap. 2—follows a corresponding framework and results to alternative architectural views, according to alternative perspectives (ITU 2014b). A representative IoT architecture framework is the IEEE P2413 (IEEE 2014).

Several technologies have emerged, which are based on Internet-of-Things (IoT) (Garcia et al. 2017): protocols like LoRaWAN,[23] Sigfox,[24] Weightless,[25] Long Term Evolution (LTE)[26] and 5th generation mobile networks (5G) enable M2M communications; Near Field Communication (NFC) (e.g., RFID and smartcards), Bluetooth Low Energy (BLE) (e.g., iBeacon, AltBeacon, Eddystone open beacon); and Visible Light Communication (VLC) are some more technologies that enable new types of smart service deployment.

3.1.13 Data, Big Data, Data Analytics and Open Data

This section deals with the emerging interdisciplinary field of Data Science, which cannot be covered within a few paragraphs. However, an attempt to demonstrate some important theoretical foundation of data within smart cities is being performed, since data concern the "power and energy" of a smart city. Data creation, flow and storage occur in every smart service execution and a corresponding layer has been defined and presented in Fig. 2.8. Data science in smart city uses this data and analytics techniques to locate and interpret rich data sources; manage large amounts of data despite potential constraints (e.g., hardware, software and bandwidth etc.); merge data sources; ensure consistency of datasets; visualize and understand data; build mathematical models using data; and produce reasonable findings (Duckett 2016).

In the previous section, the term "Big Data" was defined as the extensive volumes of data that are being created by several sources named the IoT (Tene and Polonetsky 2013). *Volume* is one of the three data characteristics in smart cities, while *variety* of type and *velocity* (speed) of capturing, transferring and processing

[22]https://tools.ietf.org/html/rfc2460.

[23]https://www.lora-alliance.org/.

[24]https://www.sigfox.com/.

[25]http://www.weightless.org/.

[26]http://www.3gpp.org/technologies/keywords-acronyms/98-lte.

are the remainders (ITU 2014b). However, big data solutions are often focused on organizing and preprocessing the data, instead of analysis.

Data in smart cities are extremely heterogeneous due to the alternative domains that produce smart services (e.g., health, education, transportation etc.). In this regard, specific technology has to create, integrate and search heterogeneous data and return unified information.

Data analysis or *data analytics* on the other hand concerns the process of data in terms of escaping the confines of structured databases, identifying correlations and conceiving new, unanticipated uses for existing information (Tene and Polonetsky 2013), while generating results from data combination. Two indicative terms prior to analytics concern *data mining* and *data harvesting* for collecting information. *Data mining* stands for techniques for seeking and retrieving information within large and complex databases (Witten and Frank 2005). *Data harvesting* reflects the collection of wide range of data within numerous disparate public and private databases, from which it can be re-published in a unified manner (Bellini et al. 2014; Snowflake Software 2012). Additionally, two indicative terms that come after data collection (mining or harvesting) concern *data reasoning* and *machine learning*. *Data reasoning* represents knowledge creation with a merge of computational logic with an understanding of context (Pawlak 2002; Lee 2011). *Machine learning* is a field of study that gives computers the ability to learn without being explicitly programmed (Simon 2013).

Different types of data can be located in a smart city, which range according to the smart service that produces or uses it (e.g., energy data, medical examination data, mobility data and government data etc.). However, different types of data are also produced by users across the city, in conjunction with sensors (e.g., car accident data). As it can be seen, data ownership and privacy issues rise, which have to be treated by smart city owners with respective policy making. An indicative protocol that respects these issues is presented on Fig. 3.10 (ITU 2014b), while a corresponding data flow model is depicted on Fig. 3.11 (BSI 2016).

Figure 3.10 shows that when a user (1) requests for data from a provider (2), several stakeholders may oblige specific rules. When data exist, data provider returns data directly after a data manager's (3) authorization or after a rule manager's (4) authorization. When data is produced, data are requested from a data issuer (5), who asks for authorization from a corresponding data manager (6).

A socio-technical perspective of this 'data flow' is illustrated in Fig. 3.11. It shows how data is created in social and physical systems, collected, transmitted, stored and possibly shared before the data can be analyzed, displayed and finally used to make decisions. At each step, there are different actors involved (e.g. the person whose actions lead to new data, the owner of a sensor, the maintainer of a web platform, various owners of the data) and social as well as technical challenges to be addressed (Mulligan and Olsson 2013; BSI 2016).

Data and smart city is an emerging and much promising topic. A search for "data harvesting" and "smart city", as well as for "data mining" and "smart city" in several scientific databases (Table 3.4) returned more than 600 articles during the period July–August 2016. Although this search did not focus on "data" and "smart

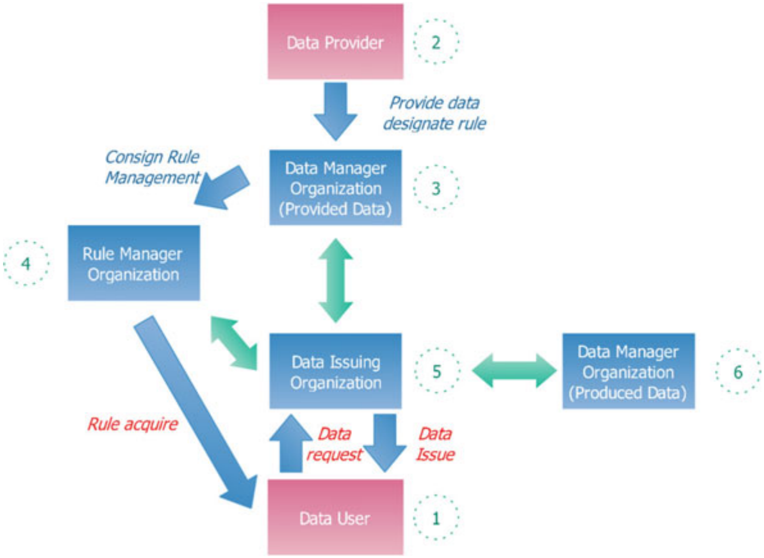
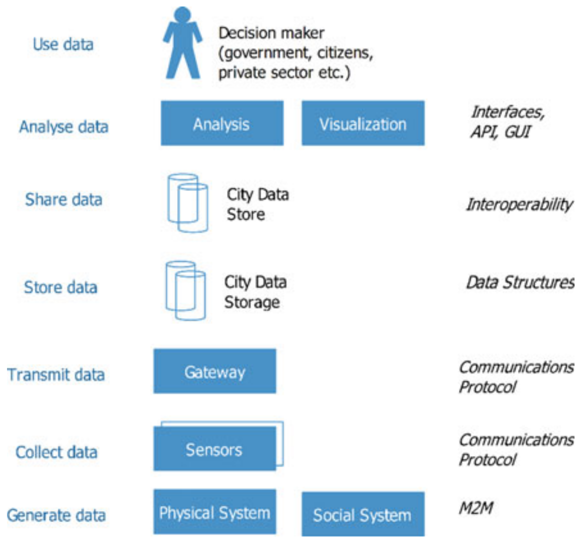


Fig. 3.10 Data use protocol (ITU 2014b)

Fig. 3.11 Data flow model (BSI 2016)



city" in general, but on how you can collect and utilize data in smart city, its results are very representative and demonstrate how this are evolves. The process of these articles is still in progress but initial results show the following important issues:

1. Articles emerge after 2012 and double after 2014 (Table 3.5; Fig. 3.12) and (Table 3.6; Fig. 3.13) while they increase radically, something that proves the

Table 3.4 Search results with regard to data mining and smart city

	Google Scholar	Scopus	IEEE	ScienceDirect	Totals
"Data harvesting" and "smart cities"	32	2	2	4	**40**
"Data mining" and "smart cities"	502	57	7	35	**601**
Totals	**534**	**59**	**9**	**39**	**641**

Table 3.5 Articles regarding "data mining" and "smart city"

Year of publication	Google Scholar	Scopus	IEEE	ScienceDirect
2000	1			
2001	2			
2002	1			
2003	2			
2004	2			
2005	1			
2006	1			
2007	1			
2008	1			
2009	4			
2010	6			
2011	14			
2012	58	6		
2013	55	10	3	5
2014	126	5	1	6
2015	148	19	3	9
2016	78	17		14

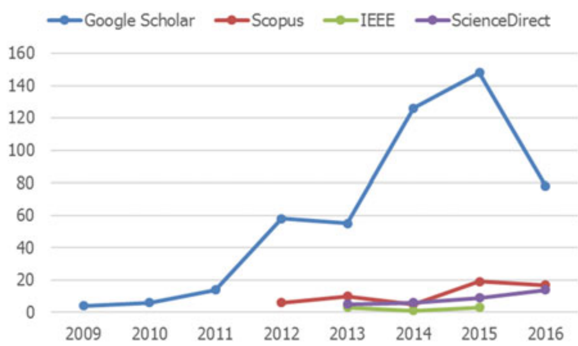


Fig. 3.12 Articles regarding "data mining" and "smart city"

Table 3.6 Articles regarding "data harvesting" and "smart city"

Year of publication	Google Scholar	Scopus	IEEE	ScienceDirect
2000				
2001				
2002				
2003				
2004				
2005				
2006				
2007				
2008				
2009				
2010	1			
2011	1			
2012	2	1		1
2013	4	1	1	
2014	7			1
2015	12			2
2016	5		1	

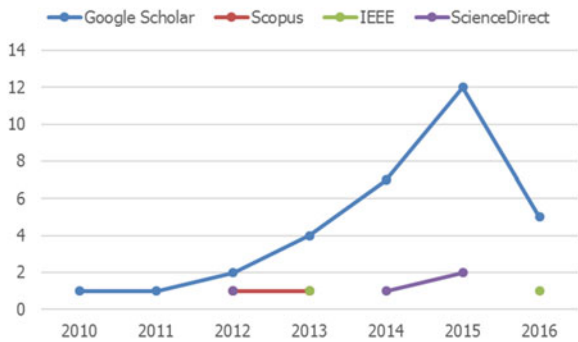


Fig. 3.13 Articles regarding "data harvesting" and "smart city"

attention that data scientists pay in smart cities. However, this finding was expected according to existing smart city literature reviews (e.g., Anthopoulos and Reddick 2015).

2. Most people discuss about smart city and big data and about smart city and IoT.
3. From the smart city 6 dimensions, special attention is given in data mining and smart mobility, while city's energy efficiency and smart safety follow.
4. An attention is paid regarding smart city and crowd-sensing, which is explained in the following section.
5. Data and cloud is also being discussed by scholars.
6. Data ontologies for smart cities have been discussed only once.

Open data on the other hand, is *data that can be freely used, re-used and redistributed by anyone—subject only, at most, to the requirement to attribute and share alike without restrictions of copyright, patents or other mechanisms of control* (ITU 2014d). Open data was initially grounded for scientific purposes in 1970s (Yu 2012), when NASA had to be supported by international partners in operating ground control stations for American satellites, but it became popular with the launch of open-data government initiatives such as Data.gov[27] (Parks 1957) and Data.gov.uk[28] (Shadbolt et al. 2012) and today is an international trend.

Moreover, ISO (2014b) defines "Open Data" in the context of Smart Cities as *a public policy that requires public sector agencies and their contractors to release key sets of government data (relating to many public activities of the agency) to the public for any use, or re-use, in an easily accessible manner. In many cases, this policy encourages this data to be freely available and distributable.*

"Open" refers to machine processed online resources that are easy to access and are put under free licenses, which enable the re-use of data by anyone for any purpose at no charge. In this respect, the main criteria for open data concern (ITU 2014d):

1. **Availability and Access**: data must be available as a whole, in a convenient and modifiable form (e.g., via the web) and mostly at a reasonable reproduction cost.
2. **Re-use and Redistribution**: terms must accompany data that permit its re-use and redistribution—including combining it with other datasets.
3. **Universal Participation**: no discrimination against data-use purposes or against persons or groups must be defined for open data (e.g., "no-commercial" restrictions).

Open datasets are usually in comma-separated value (CSV) format or in spreadsheets. Moreover, Resource Description Framework (RDF) descriptions for data is the format most integrated into current thinking about future generations of the Web as its use of URIs allows data to be identified by reference and linked with other relevant data by subject, predicate, or object (Shadbolt et al. 2012).

Moreover, Open Government Data (OGD) concern open data published by government or public organizations and it was initially grounded by Public Sector Information Directive by The European Commission in 2003 (Mutuku and Colaco 2012). OGD contribute to government transparency and to a participatory public administration, while it is supported by the vision of Linked-Data WEB (LDW), which is already well populated through initiatives such as DBpedia,[29] the DBLP[30] Computer Science Bibliography etc. (Shadbolt et al. 2012). Moreover, the Comprehensive Knowledge Archive Network (CKAN)[31] is a representative open

[27]https://www.data.gov/.

[28]https://data.gov.uk/.

[29]http://wiki.dbpedia.org/.

[30]http://dblp.uni-trier.de/.

[31]http://ckan.org/.

source data management system (DMS) for powering data hubs and data portals and it is used in several cases like the data.gov.uk. Another alternative is the CitySDK,[32] which offers several open application interfaces (API) for open data collection and dissemination.

Beyond OGD, Open Scientific Data (OSD), Open Industrial Data (OID), open enterprise data (OED) and Open Personal Data (OPD) concern other important parts of open data, which all deal with smart city (ITU 2014d). The OGD, includes geographical, environmental, weather, education, agriculture, and occupational safety as well as economic data all published by the local or regional government, which support government efficiency and transparency. The OSD on the other hand, concerns experimental data, genomes, chemical compounds, mathematical and scientific formulas, medical data practice, bioscience biodiversity etc.

Open data (ITU 2014d) consist of header or tags—for data management—and content—the main data context; they are marked by the service provider regarding their ownership; they contain time stamps with regard to their creation and expiration; versioning information regarding their update(s); anonymizer marks regarding data creator, creation time stamps, method and level regarding potential information loss. Moreover, similarly to the smart city architecture framework presented in Chap. 2, major principles with regard to open data system's architecture (ITU 2014d) concern *openness*; *extensibility*; *accessibility*; *maintainability*; *security*; and *advancement* in terms of the use of cutting edge technology (e.g., thin client). Moreover, *simplicity* is another principle for open data, since providers have to initiate publishing open data, even with one dataset. An indicative view of such an architecture is presented in Fig. 3.14 (ITU 2014d).

Open data and the open data driven-industry supports economic growth and some reports show that open data will lead to a Gross Domestic Product (GDP) increase of U.S. $13 trillion for the G20 members between 2015 and 2020 (Tisne 2014). In the smart city context, open data provide new business opportunities to data-driven companies, they simplify public transactions (e.g., for new company registration), while they enhance city planning with the analysis of utility providers' data (e.g., districts' population growth) and city's real-time monitoring. On the other hand, security issues have to be taken care for open data provision, while regulations have to define terms for open data privacy and use in a smart city.

The World Council on City Data (WCCD)[33] is the global leader in standardized city data—creating smart, sustainable, resilient, and prosperous cities. The WCCD supported the implementation of ISO 37120:2014 Sustainable Development of Communities: Indicators for City Services and Quality of Life, the new international standard; created by cities, for cities (ISO 2014a, b, c). The WCCD has developed the first ISO 37120:2014 certification system and the Global Cities

[32]http://www.citysdk.eu/.

[33]http://www.dataforcities.org/.

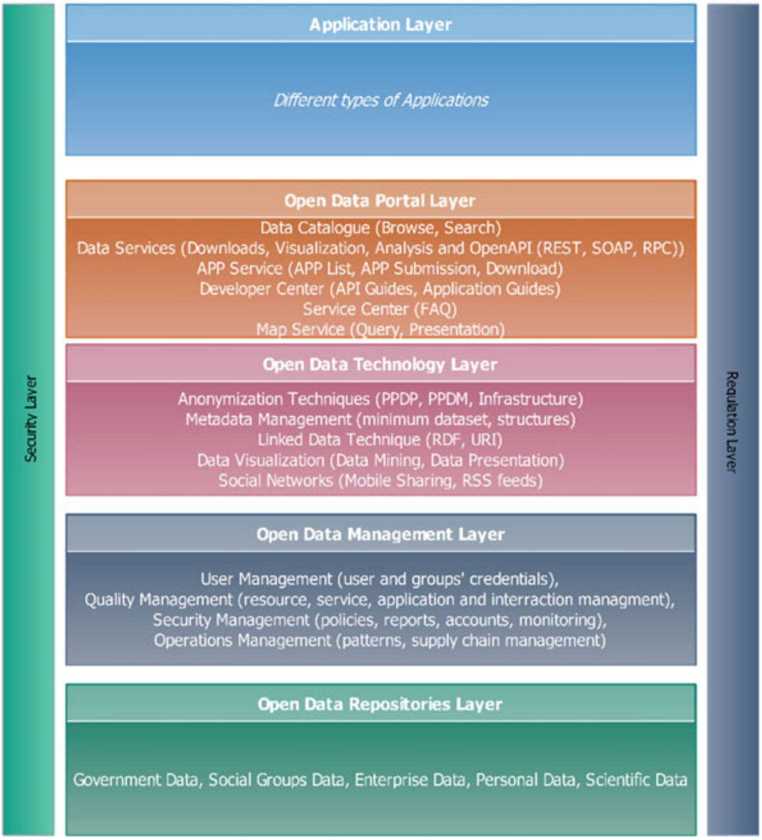


Fig. 3.14 Indicative open data multi-tier architecture [Privacy-Preserving Data Mining (PPDM), Privacy-Preserving Data Publishing (PPDP), Representational State Transfer (REST), Simple Object Access Protocol (SOAP), Remote Procedure Call Protocol (RPC)]

Registry, while its Open City Data Portal[34] allows users to explore, track, monitor and compare member cities on up to 100 service performance and quality of life indicators.

3.1.14 Crowd-Sourcing and Crowd-Sensing

Crowd-sourcing *is the process of soliciting contributions from the human crowd, a large group of self-identified volunteers, where each contributor can perform a task* via *an ICT device, this task adds a small portion to the final result* (Boutsis et al.

[34]http://open.dataforcities.org/.

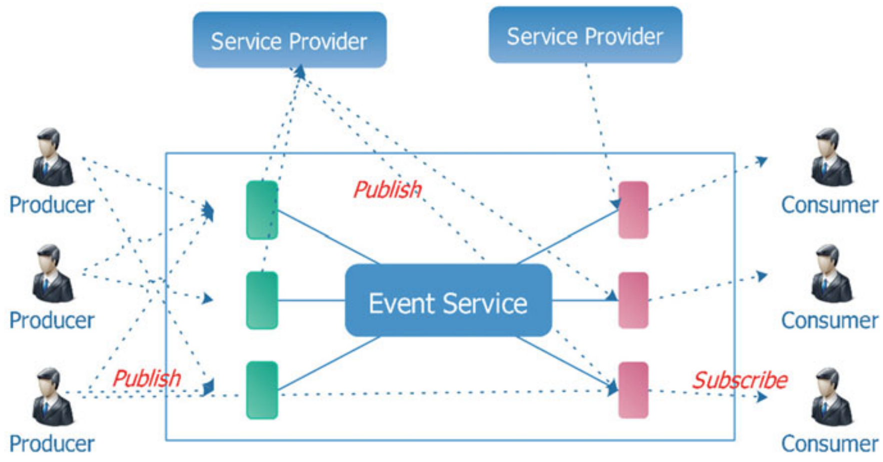


Fig. 3.15 Crowd-sensing based service

2016). Tasks are usually simple and may range from knowledge contribution (e.g., wikis) to policy consultation and social feedback (e.g., Tripadvisor[35]). In cities, these tasks focus on city services like traffic monitoring—where users identify the volume of the traffic from their corresponding location (e.g., Waze[36])—or satisfaction from local venues (e.g., Foursquare). Crowdsourcing is cost-effective but information accuracy has to be validated with the use of a reliable contributors' sample (Boutsis et al. 2016).

Crowd-sensing on the other hand, concerns the accurate tracing of *world-related information and (physical) activities of citizens that has been enabled by a spontaneous, widespread diffusion of Internet-connected sensor-equipped devices, by taking advantage of people willing to collaborate toward a continuous data harvesting process* (Cardone et al. 2015). Such devices (e.g., smartphones) enable crowd-sensing service deployment, where information is being acquired by users who are both producers and consumers at the same time (Fig. 3.15) (Farkas et al. 2015).

The above definitions show the similarities and differences between these 2 terms: both crowd-sourcing and crowd-sensing are based on volunteers' contribution via ICT devices. Crowd-sensing collects information from sensors embedded in mobile devices (e.g., smartphones) or combines sensor-based information with user-contribution (e.g., with the use of a special Mobile App where user has to check-in and define its location first).

Smart service deployment in a smart city can be based on both crowd-sourcing (e.g., for service rating and co-creation) and crowd-sensing (e.g., for a direct smart service provision) and several examples can be provided, which utilize them

[35]http://www.tripadvisor.com.

[36]https://www.waze.com/.

(Boutsis et al. 2016; Cardone et al. 2015; Farkas et al. 2015; Ram et al. 2016). Crowd-sourcing examples for instance, concern citizens who use social media to contribute with information (e.g., Foursquare check-in and facility rating); or inhabitants participate in government polls and consult policy making etc. Crowd-sensing exemplars concern mobile Apps that collect and return information about traffic (e.g., Waze); apps that collect information about local temperature etc.

3.1.15 Cloud Computing

Cloud computing stands for the use and access of multiple server-based computational resources via a digital network (WAN, Internet connection using the World Wide Web, etc.) (Hu and Chang 2012). In this regard, cloud computing *is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet)* (ISO 2014b). Clouds can be classified as public, private or hybrid and representative cloud based technologies concern Software as a Service (SaaS), Storage as a Service (STaaS) and Infrastructure as a Service (IaaS), according which a customer has remote access to software applications, storage and virtual infrastructure accordingly with similar means like a physical access (Fig. 3.16) (ITU 2014b).

Physical facilities can be virtualized and managed in a unified manner, which simplifies the overall monitoring, configuration and maintenance, with flexibility

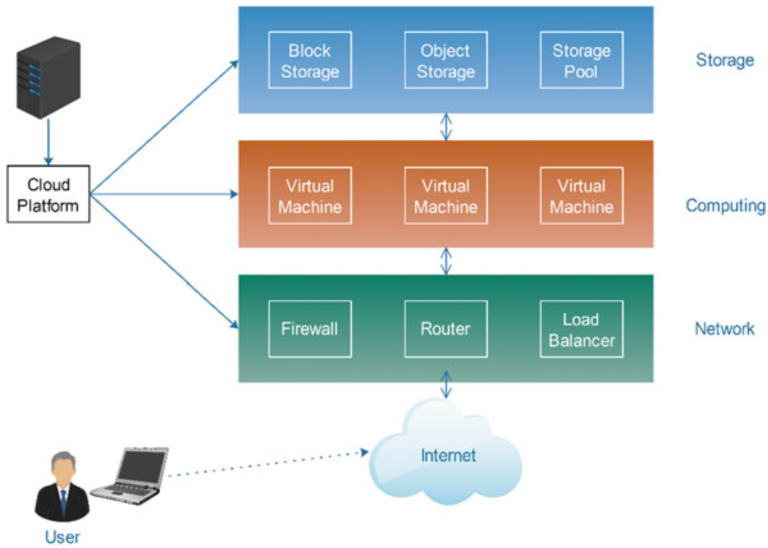


Fig. 3.16 Indicative cloud computing architecture

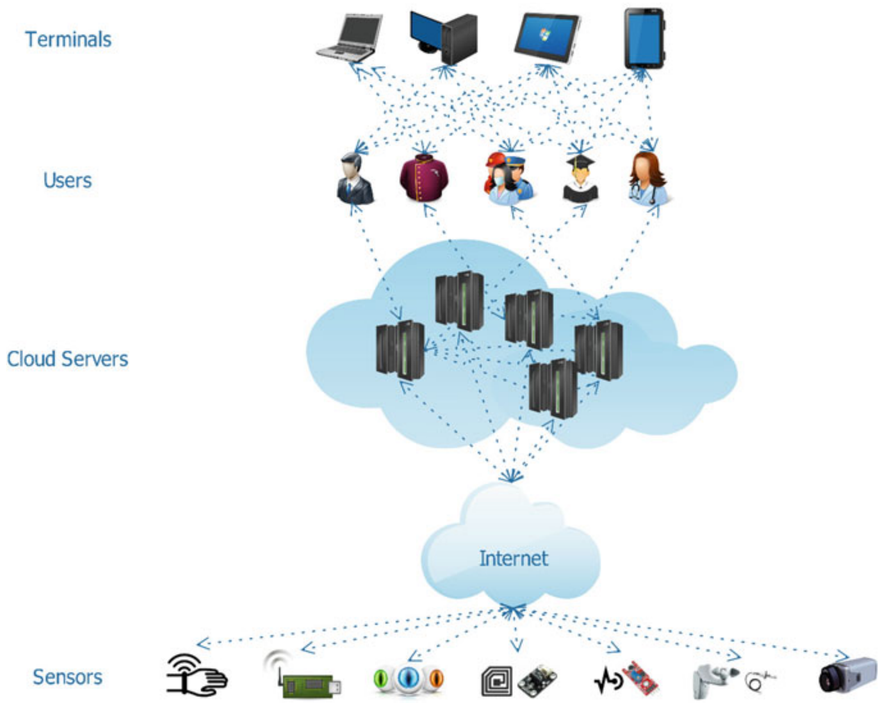


Fig. 3.17 IoT-cloud integration for smart service delivery in smart city

and at low cost, especially in a smart city environment, where IoT and cloud computing have to be integrated for individual smart service provision (Hassan et al. 2014). Such an integration enables an efficient and effective IoT-cloud for pervasive smart service delivery and can become the "corpus" for smart city evolution (Fig. 3.17).

Revision Question 1:	what are the risks that deal with water security?
Revision Question 2:	name the water service utilities supported by technology.
Revision Question 3:	what is smart water management technology?
Revision Question 4:	what does city's energy efficiency stand for?
Revision Question 5:	name 3 policies that enhance city's energy efficiency.
Revision Question 6:	list the process steps for urban energy efficiency enhancement.
Revision Question 7:	what is the role of smart grids?
Revision Question 8:	what are the intelligent transportation system's components?
Revision Question 9:	on what smart health service provision is based?

Revision Question 10:	name 3 use cases that can be handled by a smart health system.
Revision Question 11:	what does public safety concern and how can ICT contribute?
Revision Question 12:	how can ICT enhance education services?
Revision Question 13:	name 2 indexes that measure city's attractivity.
Revision Question 14:	list the infrastructure components of smart waste management.
Revision Question 15:	describe the structure of a smart building.
Revision Question 16:	name 3 indexes that measure smart government performance.
Revision Question 17:	what does smart economy stand for?
Revision Question 18:	what does the network layer contain?
Revision Question 19:	name the requirements for smart city.
Revision Question 20:	list 3 typical networking technologies.
Revision Question 21:	list the four scenarios that define the role of a sensor network.
Revision Question 22:	what is Machine-to-Machine (M2M) communications?
Revision Question 23:	provide your definition for the Internet-of-Things (IoT).
Revision Question 24:	what is the role of Data Science and especially in smart city?
Revision Question 25:	what does data analytics mean?
Revision Question 26:	what is the role of data in smart city?
Revision Question 27:	what does big data mean?
Revision Question 28:	provide your definition for open data.
Revision Question 29:	what is difference between crowd sourcing and crowd sensing?
Revision Question 30:	define cloud computing and describe a corresponding architecture.

3.2 Smart Services

Smart services concern a "core element" of a smart city, since they support the realization of urban "intelligence" in terms of people, economy, governance, environment, mobility and living. Smart services *concern the "products/services/utilities" that the smart city delivers to its stakeholders* via *its soft or hard facilities* and aim to enhance quality of life within a city, and in this respect to improve city's "livability" (Anthopoulos et al. 2016).

Table 3.7 Smart service classes proposed by ISO and ITU

ISO	ITU
1. E-government 2. Transport 3. Logistics 4. Public safety 5. Healthcare 6. Energy and resources 7. Environmental protection 8. Climate change adaptation 9. Community and household	1. Smart water 2. Smart energy 3. Smart transportation 4. Smart healthcare 5. Smart safety/emergency 6. Smart education 7. Smart tourism 8. Smart waste management 9. Smart buildings 10. E-government 11. E-commerce

Smart service types cannot be easily pre-defined, since they are the outcome of local innovation, which cannot be pre-defined either, but instead it is the product of citizens' and businesses' creativity. However, both ISO (2014b) and ITU (2014a, b, c, d) provided with proposed smart service classes (Table 3.7).

In attempt to realize the types of smart services that smart cities offer, official websites of several cities—entitled "smart" or "self-claiming to be smart" in literature—were examined in the period August and December 2015 with regard to their smart services. Examination was not limited to the online offered services, but an effort was made to identify all the types of smart services that the city offers or plans to offer according to undertaken initiatives (Table 3.8) (Anthopoulos et al. 2016).

The examination that was followed attempted to recognize and classify smart services in service groups, that adopt ISO and ITU classes (Table 3.7) and that are being presented in Fig. 2.7. The examination's findings obliged also the following:

1. *Smart healthcare* service had to split to *smart health* and *smart care* classes;
2. Extra service groups that concerned Giffinger et al. (2007) evaluation indexes that were not mentioned from the beginning had to be added: (a) people; (b) environment; and (c) living;
3. A service group that deals with urban planning, urban renovation and new districts' creation had to be added, which serves smart city or data utilization for future city improvements.

All the above resulted to the following smart service classes:

1. Smart water;	9. Smart buildings;
2. Smart energy;	10. Smart government;
3. Smart transportation;	11. Smart economy;
4. Smart healthcare;	12. Smart people;
5. Smart safety/emergency;	13. Smart environment;
6. Smart education;	14. Smart living;
7. Smart tourism;	15. Smart planning
8. Smart waste management;	

Table 3.8 Smart cities that were examined for their offered smart services

	Smart city	Official website
1	Amsterdam (The Netherlands)	www.amsterdam.nl
2	Ballarat (Australia)	www.ballarat.vic.gov.au
3	Barcelona (Spain)	www.barcelona.cat
4	Beijing (China)	www.ebeijing.gov.cn
5	Berlin (Germany)	www.berlin.de
6	Besancon (France)	www.besancon.fr
7	Birmingham (U.K.)	www.birmingham.gov.uk
8	Boston (U.S.A.)	www.cityofboston.gov
9	Bottrop (Germany)	www.bottrop.de
10	Bristol (U.S.A.)	www.ci.bristol.ct.us
11	Cape Town (South Africa)	www.capetown.gov.za
12	Chattanooga (U.S.A.)	www.chattanooga.gov
13	Cleveland (U.S.A.)	www.city.cleveland.oh.us
14	Copenhagen (Denmark)	www.kk.dk
15	Curitiba (Brazil)	www.curitiba.pr.gov.br
16	Dakota County (U.S.A.)	www.co.dakota.mn.us
17	Dubai (UAE)	www.dubai.ae/en
18	Dublin (Ireland)	www.dublin.ie
19	Dublin (U.S.A.)	www.ci.dublin.ca.us
20	Eindhoven (The Netherlands)	www.eindhoven.nl
21	Frankfurt (Germany)	www.frankfurt.de
22	Gdansk (Poland)	www.gdansk.pl/en
23	Gold Coast City (Australia)	www.goldcoast.qld.gov.au
24	Gujarat (India)	www.gujaratindia.com
25	Helsinki (Finland)	www.hel.fi
26	Hong Kong (China)	www.gov.hk
27	Ipswich (Australia)	www.ipswich.qld.gov.au
28	Issy-Les-Moulineaux (France)	www.issy.com
29	Jubail (Saudi Arabia)	www.rcjy.gov.sa/en-us/jubail/Pages/default.aspx
30	Kalundborg (Denmark)	www.kalundborg.dk
31	Lavasa (India)	www.lavasa.com
32	London (U.K.)	www.cityoflondon.gov.uk
33	Los Angeles (U.S.A.)	www.lacity.org
34	Lyon (France)	www.lyon.fr
35	Malaga (Spain)	www.malaga.eu
36	Malmo (Sweden)	www.malmo.se
37	Masdar (Uae)	www.masdar.ae
38	Melbourne (Australia)	www.melbourne.vic.gov.au
39	Milan (Italy)	www.comune.milano.it
40	Moncton (Canada)	www.moncton.ca

(continued)

Table 3.8 (continued)

	Smart city	Official website
41	Munich (Germany)	www.muenchen.de
42	New York (U.S.A.)	www1.nyc.gov
43	Ottawa (Canada)	www.ottawa.ca/en
44	Paredes (Planit Valley, Portugal)	www.cm-paredes.pt
45	Paris (France)	www.paris.fr
46	Pedra Branca (Brazil)	www.cidadepedrabranca.com.br
47	Porto Alegre (Brazil)	www.portoalegre.rs.gov.br
48	Quebec City (Canada)	www.ville.quebec.qc.ca
49	Recife (Brazil)	www.recife.pe.gov.br
50	Riverside (U.S.A.)	www.riversideca.gov
51	Rotterdam (The Netherlands)	www.rotterdam.nl
52	San Fransisco (U.S.A.)	www.sfgov.org
53	Seoul (South Korea)	www.seoul.go.kr
54	Shanghai (China)	www.shanghai.gov.cn
55	Shenyang (China)	www.shenyang.gov.cn
56	Singapore	www.gov.sg
57	Songdo (South Korea)	www.songdo.com
58	Sopron (Hungary)	www.sopron.hu
59	Stockholm (Sweden)	www.international.stockholm.se
60	Suwon (South Korea)	www.suwon.go.kr
61	Sydney (Aystralia)	www.cityofsydney.nsw.gov.au
62	Tallinn (Estonia)	www.tallinn.ee
63	Taoyuan (Taiwan)	www.tycg.gov.tw/eng
64	Tianjin Binhai (China)	www.bh.gov.cn
65	Tokyo (Japan)	www.metro.tokyo.jp
66	Toronto (Canada)	www.toronto.ca
67	Trikala (Greece)	www.trikalacity.gr
68	Trondheim (Norway)	www.trondheim.no/engelsk
69	Urumqi (China)	www.urumqi.gov.cn
70	Vancouver (Canada)	www.vancouver.ca
71	Vienna	www.wien.gv.at/english
72	Windsor-Essex (Canada)	www.citywindsor.ca
73	Winnipeg (Canada)	www.winnipeg.ca
74	Wuxi (China)	www.wuxi.gov.cn

Moreover, some service aggregation was performed, which was based on some agreements, like the following (Anthopoulos et al. 2016):

1. Initiatives for communities with special needs like jobless, elderly, female and disabled were assigned to smart care category.
2. Vocational training services were considered to belong to smart education class.

3. Heritage provision and protection services and economic support (e.g., loan provision for settlement) were assigned to smart economy class, since local growth is significantly based on real estate business.
4. Several types of consulting services (e.g., training and new business registration) were assigned to corresponding categories (e.g., smart education and smart economy respectively).
5. Volunteer and cultural activities were considered to belong to smart people class.
6. Metro-WiFi infrastructure and pet related services were respected to belong to smart living class, since they both are consider to be related with local quality of life.

All the identified smart services are presented on Table 3.9. Some particular findings that demonstrate the types of the offered smart services can be briefly mentioned and concern the following (Anthopoulos et al. 2016): Amsterdam that has shifted twice from broadband to smart and then to eco-city, developed the Ijburg district (*Planning*) of 4 artificial islands, which extends existing urban space and creates new smart districts. Ballarat offers donation services to support new habitants, while it offers land for business installation with the Ballarat West Employment Zone (BWEZ) initiative (*Planning*). Barcelona offers renting services for empty apartments (*Tourism*), while it has created smart blocks (*Planning*) for enhancing calm streets. Beijing emphasizes on smart government services with citizen smart cards. Berlin supports new business registration with various packages and start-up centers (*Economy*). Besancon engages citizens with initiatives like elderly council and discrimination campaigns (*People*). Boston performs city renovation (*Living*).

Cape Town encouraged local business engagement for local touristic product upgrade (*Economy*), while it develops new urban area (Oude Molen) (*Planning*). Copenhagen offers digital safety cards (*Safety*). Dubai is famous for its business free zones, policies and infrastructure that attracts new business installation (*Economy*). Frankfurt offers almost all types of smart services but it focuses on smart energy (*Energy*), on which it assigns even tourism services (e.g., KLIMAtours with regard to visits on energy efficient large buildings).

Gold Coast City emphasized smart transportation (*Transportation*). Gujarat performs climate-change monitoring and focuses on corresponding initiatives (*Environment*). Issy-Les-Moulineaux in Paris has developed the Smartcity + mobile application, via which has enabled collaboration between groups of common interests (e.g., elderly people) (*People*). Jubail develops a city from scratch (Jubail II) (*Planning*) that embeds all types of smart services. Lavasa renovated most of its landscape for tourism and business attraction (*Economy*). London offers sets of data and mobile services to its visitors and habitants (*Economy*). City of Los Angeles encourages business installation (*Economy*) with various activities like the Empowerment Zone.

Masdar has developed smart building prototypes that enhance local business' exports (*Economy*). Melbourne was rated the most livable city in 2015 and appears

Table 3.9 Smart service classification and calculation for the examined smart cities

City	Water	Energy	Transp.	Health	Care	Saf./ Emer.	Educ.	Tourism
Amsterdam			3			2		3
Ballarat	1	1	2		4	1	3	
Barcelona			2		2		2	2
Beijing	1	1	5		1	1	2	
Berlin								3
Besancon	2	2	7	4	8		4	
Birmingham			3		6	6	2	1
Boston					6	1		
Bottrop	1				5		1	
Bristol					1			1
Cape Town			2				1	1
Chattanooga			2					
Cleveland				1	2	2	4	
Copenhagen			3		1	1		
Curitiba			1		8		3	1
Dakota County				3	6	3	1	
Dubai			1		6			1
Dublin					1		1	
Dublin (USA)	1		1			1	1	
Eindhoven		1	2		3		1	1
Frankfurt		3	2		6	3	6	2
Gdansk	1				5		1	1
Gold Coast City	1		4		2			
Gujarat					1			
Helsinki			3		6		1	
Hong Kong	1	2	1	1	5		1	1
Ipswich		1	3		1	2	1	1
Issy-Les-Moulineaux		1	5	2	3		1	
Jubail	1						1	
Kalundborg		1		1	4	1		
Lavasa							1	5
London			9		11	2	2	5
Los Angeles			1		7	2		1
Lyon			2	4	8			2
Malaga		1			4	1	1	2
Malmo	1	3	2		7	1	2	2
Masdar		2					2	
Melbourne		3	3		7			1
Milan			3	1	8		2	2
Moncton	1	1	1		2			

(continued)

Table 3.9 (continued)

City	Water	Energy	Transp.	Health	Care	Saf./ Emer.	Educ.	Tourism
Munich			2		1			
New York					2			1
Ottawa	1			1	3			1
Paredes					2			1
Paris					1			1
Pedra Branca			3					
Porto Alegre			1		2			1
Quebec					1	2		
Recife			1		2	1	1	1
Riverside	1	2	2		3	1		1
Rotterdam	1				2			2
San Francisco		1	1		2			
Seoul			1		1			2
Shanghai				1	1		1	
Shenyang								1
Singapore			1	1	2		1	
Songdo	2	2	1	1			1	
Sopron							1	2
Stockholm			1		4		3	1
Suwon	1	1	1	1	4		1	
Sydney			2		5			
Tallinn	1						1	1
Taoyuan	1		1		4	1		1
Tianjin Binhai								1
Tokyo					1	1	1	1
Toronto	1	1	1	1	4			
Trikala			2		1			3
Trondheim			1		5		1	1
Urumqi				1	2	1	1	1
Vancouver	1	1	2	1	1	1		
Vienna			2	1	2		1	
Windsor-Essex			1		2			1
Winnipeg						1	1	2
Wuxi					2		2	
Totals	**22**	**31**	**100**	**26**	**209**	**39**	**65**	**66**

City	Waste	Build.	Gov.	Econ.	People	Env.	Living	Plan.	
Amsterdam				4	2			1	**15**
Ballarat	1		1	3	2	1	1	1	**22**
Barcelona	1			11	1	3	1	2	**27**
Beijing			2	3		2			**18**

(continued)

Table 3.9 (continued)

City	Waste	Build.	Gov.	Econ.	People	Env.	Living	Plan.	
Berlin				11	1				**15**
Besancon	1		1	12	5	5		2	**53**
Birmingham	7		6	10	5	2	1	3	**52**
Boston	1		1	4			1		**14**
Bottrop				3		2	1		**13**
Bristol	1		2	2		1	1		**9**
Cape Town			3	3			1	2	**13**
Chattanooga	1			5	1				**9**
Cleveland	4		1	5			2		**21**
Copenhagen	1		2	4			3		**15**
Curitiba	1			2					**16**
Dakota County	3	1	5	5		1			**28**
Dubai			1	10					**19**
Dublin	2			6		1			**11**
Dublin (USA)	1		1	3		5	2		**16**
Eindhoven	2		2			1			**13**
Frankfurt	1	1	3	10	6	3	1	2	**49**
Gdansk	1		1	6		3	1	1	**21**
Gold Coast City				3		2	3		**15**
Gujarat			2	3		2			**8**
Helsinki			2	6					**18**
Hong Kong	1	2	6	6		3	2		**32**
Ipswich	2		1	3	1	4	4	1	**25**
Issy-Les-Moulineaux	1	1	1	4	3	4			**26**
Jubail			2	3	1	7			**15**
Kalundborg	1		2	10	1	4		1	**26**
Lavasa									**6**
London	5		3	6	2	4	1		**50**
Los Angeles	2		2	6		2	2	1	**26**
Lyon	1			4		5	3		**29**
Malaga			5	8		1	1		**24**
Malmo	1	1	2	7		12	2	1	**44**
Masdar		2	1	6		2			**15**
Melbourne	3		2	2	1	1	2		**25**
Milan	1		3	4	2	6	3	2	**37**
Moncton	1		1			4	2	1	**14**
Munich				7		4			**14**
New York	2		3	3	1	1	1	1	**15**
Ottawa	1			4					**11**
Paredes			2	3	2	2		2	**14**

(continued)

Table 3.9 (continued)

City	Waste	Build.	Gov.	Econ.	People	Env.	Living	Plan.	
Paris				7			1	1	**11**
Pedra Branca								2	**5**
Porto Alegre	1		1	1					**7**
Quebec	1			7	2	2			**15**
Recife	1			4	1	2	1		**15**
Riverside	1	2	1	6	1	1	1	2	**25**
Rotterdam				4	1	1		1	**12**
San Francisco		2		1	1	2			**10**
Seoul	1		1	7	2	2	1	3	**21**
Shanghai				3		1		3	**10**
Shenyang				6	1	1	1		**10**
Singapore			2	5	1	1	1		**15**
Songdo	2	2		3	1		3	2	**20**
Sopron				2	3	1			**9**
Stockholm			1	2	2	2	1	7	**24**
Suwon			6	3				2	**20**
Sydney	3	2		3	2	3	1	6	**27**
Tallinn				7		1			**11**
Taoyuan	1		1	4					**14**
Tianjin Binhai			3	3				1	**8**
Tokyo			2	5		1	4	3	**19**
Toronto	1		1	4	3	3		1	**21**
Trikala			2				2		**10**
Trondheim	1			3	1	3			**16**
Urumqi				4		1			**11**
Vancouver	1	2	2	3	2	1		4	**22**
Vienna				4	2	3	2	3	**20**
Windsor-Essex	1		1	3	1	1	2	2	**16**
Winnipeg	1		2	7	2		3	1	**20**
Wuxi				7				1	**12**
Totals	**67**	**18**	**98**	**339**	**66**	**133**	**66**	**69**	

to mostly offer *care*, *energy* and *waste management* services. Milan offers almost all types of smart services but it worth mentioning the use of an economic index (iSEE) to filter the eligible citizens to access care services (*Care*) and the action plan for sustainable mobility (*Transportation*). Munich founded a corresponding municipal company (SWM) to monitor climate-change effects (*Environment*). The City of New York offers a significant smart service portfolio like the City Record Online, the citizen identity (IDNYC) and the WasteMatch via a set of online applications that enable access to care and government services (*Government*), environmental sensitivity (*Environment*) and waste management respectively.

Paredes has undertaken several innovative initiatives for environmental protection (*Environment*)—like the PlanIT Valley action plan—and for creative communities (*People*). Paris develops plans for sustainability (*Planning*). Recife encourages local economic growth (*Economy*) with various initiatives like local technicians' support. Several efforts for new and innovative business growth (*Economy*) were identified in Quebec City, which concern digital entertainment (*People*), optical and information technology (*Economy*). Riverside on the other hand, among its various initiatives planned the "Smart Riverside" project, with which empowers living with technology (*Living*).

San Francisco launched the "Adopt-a-Street" program, with which it strengthens social cohesion, engagement and environmental protection (*Living and Environment*). Seoul is famous for its planning activities for sustainable growth, living improvement and climate change (*Planning*), which were confirmed with this study (2030 Seoul Master Plan) and by its participation in the C40 city coalition for climate change. New Songdo district from scratch is one of the outcomes from Seoul efforts, which embeds all types of smart services for sustainable living. Similarly, Suwon in South Korea is an excellent e-government case (*Government*). Shanghai develops the Pudong New District to boost foreign investments (*Economy*), while it has drafted a smart city plan to attract business relocation (*Planning*). Singapore offers the eCitizen portal for e-government service provision (*Government*). Sopron developed its synonymous "Sopron Innovation Park" to empower new business growth (*Economy*). Stockholm is a famous green city (*Environment*), while it performs excellent in its sustainable planning (*Planning*) with its Vision 2030 for sustainable growth; Söderort vision for regional development; Kista Science city for knowledge econmy; The new Slussen for cultural and touristic service provision; Hagastaden district renovation; and the Royal Seaport renovation to enhance trade and business growth. Similarly, Syndey has its Sustainable Sydney 2030 master plan (*Planning*), with lots of specified targets for environmental enhancement, energy efficiency and city renovation; Open Sydney for touristic and cultural growth; past Sydney Local Environmental Plan 2012 that enabled green building installation and urban farming.

The e-School interactive learning environment (*Education*) was one of the best achievements of Tallinn. Taoyuan encourages business installation in its 29 industrial zones (*Economy*), to which offers several digital public services (*Government*). Similarly, Tianjin offers free trade zones in its ports, it has developed the Binhai new area for new business installation (*Economy*), while it participates in the Sino-Singapore-Tianjin Eco-City coalition (*Planning*) for sustainable and eco-friendly growth. Toronto has developed its action plan for sustainable growth too (*Planning*), while it enhances creativity (*Economy*) with various initiatives like the StreetARToronto. Trikala installed crucial smart infrastructure (e.g., broadband networks, intelligent transportation, smart health etc.) during the last decade (*Living*), but recently emphasized on *transportation* and *tourism*. Trondheim offers several opportunities for businesses that belong to the energy industrial sector

(*Economy*). Vancouver developed its action plan for sustainable living, energy efficiency and emission control (*Environment*), while it has separated the city in zones according to different uses (*Planning*). Vienna utilized European funding opportunities for several environmental-related projects (*Environment*), while the new district of Aspern and its smart city plan (*Planning*) shows the city future by 2050. Similarly, Windsor-Essex has developed its plan for environmental protection (*Environment*), while it offers the Biddingo smart application for online trading (*Economy*). Finally, Winnipeg encourages new business development (*Economy*) with several programs (labeled e.g., Eureka, AssentWorks etc.), while it offers several e-government services (*Government*).

The results from the above investigation (Anthopoulos et al. 2016) show that technology alone has not been utilized for smart service provision yet, but planning and dedicated efforts initiate innovation in the urban space, which is supported by technology. In this regard, smart services are expected to grow further, accompanied by corresponding technology too (e.g., how can technology help a beneficial to locate shelter?). Moreover, findings show that smart cities prioritize the deployment of services for smart economy and smart care, while smart environment follows. This last outcome shows that existing smart service standardization partially succeeds in its purposes and it has to be reconsidered with regard to smart service specification. Moreover, smart city race is a reality and it is expected to grow since the smart city industry grows too.

Revision Question 1: describe the role of smart services in smart city.
Revision Question 2: list 8 smart service classes.
Revision Question 3: can you describe a particular smart service case?

3.3 Smart City Standards

Today, a strong smart city competition has been grounded that transforms the emerging smart city market (Anthopoulos and Reddick 2015) to an arena, where different types of "race" take place: industrial vendors compete regarding their market share in individual smart technology deployment; cities compete in terms of inhabitants', visitors' and investments' attraction (Anthopoulos and Fitsilis 2013); and standardization bodies struggle regarding whose specifications and guidelines will favor the majority of players (Tables 3.10 and 3.11). Identifying the competitive standards is a complex and demanding procedure, since several technologies appeared previously to deal with the smart city ecosystem (BSI 2016):

- Services. Company Organization, Management and Quality. Administration. Transport. Sociology
- Health Care Technology
- Environment. Health Protection. Safety
- Energy and Heat Transfer Engineering
- Electrical Engineering
- Electronics
- Telecommunications. Audio and Video Engineering
- Information Technology. Office Machines
- Road Vehicles Engineering
- Railway Engineering
- Packaging and Distribution of Goods
- Construction Materials and Building
- Civil Engineering
- Domestic and Commercial Equipment. Entertainment. Sports.

Standardization refers to the consistent use of methodologies, procedures, tools, and techniques specified above the level of individual projects (Gauch and Blind 2015; Wettig 2002). Standards contain specification documents, rules and guidelines for product or process development (Gauch and Blind 2015), while they establish technological convergence in different industrial sectors (Moore 1979). With regard to smart city standards, standardization does not aim to control and limit innovation development, but to define requirements for individual solutions' interoperability, as well as smart city components integration. Indicatively, several companies develop competitive smart city solutions today (ANSI 2016), which will be benefit by standardization efforts:

1. Cisco Smart + Connected Communities Solutions[37]
2. Cityzenith big data solutions[38]
3. Ericsson[39]
4. Esri[40] 3D city model creation engine
5. General Electric[41]
6. Hitachi[42]
7. IBM[43]
8. Microsoft[44] City Next

[37]http://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities.html.

[38]http://www.cityzenith.com/.

[39]http://www.ericsson.com/thinkingahead/networked_society/city-life.

[40]http://www.esri.com/software/cityengine.

[41]http://www.gesustainability.com/.

[42]http://social-innovation.hitachi/en/solutions/index.html.

[43]http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/.

[44]https://enterprise.microsoft.com/en-us/industries/citynext/.

9. Oracle[45] Smart City Platform Solution
10. Philips[46] smart lighting systems
11. Schneider Electric[47]
12. Siemens[48]
13. Streetline, Inc.[49] sensor-enabled applications3
14. Xerox Transportation Solutions.[50]

Although much of this chapter's material has been extracted from one of the international standards developed by the ITU, a few more competitive standards for smart cities exist, from which only the ones that discuss about smart city directly—and not particular technologies—are compared and analyzed (Tables 3.10 and 3.11). ISO drafted its Preliminary Report in 2014 (ISO 2014b), with which it aimed to define the smart city and recognize its standardization requirements. ISO developed the 37120:2014 standard, which defines and establishes recommendations for 21 sets of indicators to steer and measure the performance of city services and quality of life and the 37101:2016 management system for sustainable development. Moreover, it drafted the 37150:2014 technical report, the technical specifications document 37151:2015—principles and requirements for community infrastructure performance metrics—while it gives recommendations for community infrastructures. Now, ISO works on the development of the 37153:2017 standard, in organization's attempt to comply with United Nations (UN) sustainable development agenda entitled "Transforming Our World: The 2030 Agenda for Sustainable Development" (United Nations 2015). This last document describes a community infrastructure maturity model (CIMM) and a standardized approach for the assessment and improvement using the CIMM. Furthermore, ISO provides several specification documents and reports for individual smart city components (e.g., ISO/TR 28682:2008 for Intelligent Transport Systems).

The International Electrotechnical Commission (IEC) established a Systems Evaluation Group (SEG) on Smart Cities[51] in 2013. This group considered the smart city as a system of systems, which enables vertical integration from sensors, to low cost communication, real time analysis and control, and horizontal integration of historically isolated systems up to citizen based services (IEC 2014). Moreover, it reviewed existing standards and it is drafting 3 reports with regard to relevant existing standards, a reference architecture and generic use cases and a corresponding implementation roadmap. The identified system consists of

[45]http://www.oracle.com/us/industries/public-sector/national-local-government/city-platform/index.html.

[46]http://www.lighting.philips.com/main/smartcities.

[47]http://www.schneider-electric.com/smartcities.

[48]http://www.usa.siemens.com/sustainable-cities/.

[49]http://www.streetline.com/.

[50]https://www.xerox.com/en-us/services/transportation-solutions.

[51]http://www.iec.ch/dyn/www/f?p=103:186:0::::FSP_ORG_ID,FSP_LANG_ID:10330,25.

Table 3.10 Competitive smart city standards

Standardization body	Standard
International Standards Organization (ISO) (2014a, b, c, 2015, 2016)	ISO/TR 37101:2016 Sustainable development in communities ISO/TR 37120:2014 Sustainable development of communities—indicators for city services and quality of life ISO/TR 37150:2014 Smart community infrastructures—lessons learned ISO/TS 37151:2015 Smart community infrastructures—principles and requirements for performance metrics
International Telecommunications Union (ITU) (2014a, b, c, d)	Focus group on smart sustainable cities (FG-SSC) Study Group 5 (SG5): environment and climate change[a] Study Group 20 (SG20)[b]: internet of things (IoT) and smart cities and communities (SC&C)
International Electrotechnical Commission	Systems evaluation group (SEG) on smart cities
American National Standards Institute (ANSI)[c]	The ANSI network on smart and sustainable cities (ANSSC)
National Institute of Standards and Technologies (NIST) (2014, 2016)	IoT-enabled smart city framework[d] Global city teams challenge
European Standards Organizations (CEN/CELENEC/ETSI[e,f]) (2015, 2016)	Report with definitions and recommendations Development of system standards for smart cities and communities' solutions
British Standards Institute (BSI) (2014)	PAS 180 smart city terminology PAS 181 smart city framework standard PAS 182 Smart city data concept model PD 8100 on smart city overview—a guide for city managers PD 8101 Smart cities—guide to the role of the planning and development process BS 8904 Guidance for community sustainable development provides a decision-making framework that will help setting objectives in response to the needs and aspirations of city stakeholders BS 11000 collaborative relationship management
German Standards (DKE/DIN) (2014)	German smart city standardization roadmap
Spanish Standards (AENOR)[g]	UNE 178301 on open data UNE 178303 requirements for municipal assets' management UNE-ISO 37120 adopts ISO urban sustainability indicators

(continued)

Table 3.10 (continued)

Standardization body	Standard
Polish Committee for Standardization (PKN)	Recommendations for smart sustainable city standardization[h]
China National IT Standardization TC (NITS)	Started standardization work on smart cities (ISO 2015; CAICT and PDSF 2014)

[a]http://www.itu.int/en/ITU-T/studygroups/2013-2016/05/Pages/default.aspx
[b]https://www.itu.int/en/ITU-T/studygroups/2017-2020/20/Pages/default.aspx
[c]https://www.ansi.org/standards_activities/standards_boards_panels/anssc/overview.aspx?menuid=3
[d]https://pages.nist.gov/smartcitiesarchitecture/community/
[e]http://www.cencenelec.eu/standards/Sectors/SmartLiving/smartcities/Pages/default.aspx
[f]https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/353-scc-03-2015.html
[g]https://eu-smartcities.eu/content/new-set-smart-cities-standards-spain
[h]http://www.pkn.pl/sites/default/files/annual_report_2013.pdf

connected components that deal with energy, transportation, water, buildings and city services (IEC 2016).

ITU adopted ISO definitions and requirements and composed 21 technical reports and specifications for smart sustainable cities (SSC). These documents range from an analysis of a smart city architecture framework, to key performance indicators and individual documents for several smart city components (e.g., buildings, water etc.). Moreover, ITU provided details for corresponding technologies that deal with smart city (e.g., open data, cloud etc.). Since June 2015, ITU has transferred its SSC activities to the Study Group 20 (SG20) and Study Group 5 (SG5). SG20 works on standardization requirements of the Internet of things (IoT) and smart cities and communities (SC&C), while SG5 is responsible for studies on methodologies for evaluating ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way.

The American National Standards Institute (ANSI) in the U.S.A. launched a forum in 2014 for information sharing and coordination on voluntary standards, conformity assessment and related activities for smart and sustainable cities in the U.S. and abroad, which was entitled The ANSI Network on Smart and Sustainable Cities (ANSSC). ANSSC supported the development of corresponding ISO 37120:2014 standard, while it encourages the adoption of the relative standard ISO 18091: 2014, Quality management systems—Guidelines for the application of ISO 9001:2008 in local government too (ANSI 2016).

The National Institute of Standards and Technology (NIST) in the U.S.A. has triggered 2 initiatives (Global City Teams Challenge and the working group for Internet-of-Things (IoT) Enabled Smart City Framework) in its attempt to define a smart city standard. The IoT framework is being developed by 3 working groups. Its definition is based on an attempt to identify applications' Pivotal Points of Interoperability (PPI), which will enable technological standardization without limiting innovation development (NIST 2015).

Table 3.11 Comparison and analysis of smart city standards

Standard	Specifications and guidelines
ISO/TR 37101:2016	Management system for sustainable development Requirements with guidance for use, sets out requirements and guidelines to help communities become more sustainable
ISO/TR 37120:2014	City indicators (economy, education, energy, environment, finance, fire and emergency response, governance, health, shelter, solid waste, telecommunication and innovation, transportation, urban planning, waste water, water and sanitation)
ISO/TR 37150:2014	Technical report and review on metrics for smart community infrastructures (energy, water, waste, transportation, ICT) Environmental: GHG emissions, resource efficiency, pollutant emissions Social: reliability, availability, service quality Economic: value for money, resilience, expandability, operational efficiency, easy maintenance
ISO/TS 37151:2015	Smart community infrastructures—principles and requirements for performance metrics Principles: relating community issues regarding infrastructure performance; stakeholders to be considered Metrics' performance requirements: residents', community managers' and environmental perspectives
ISO/CD 37153:2017	Smart community infrastructures—maturity model for assessment and improvement
International Electrotechnical Commission Systems Evaluation Group (SEG) on Smart Cities	Report with relevant existing standards Reference architecture and generic use cases Implementation roadmap
ITU Focus Group on Smart Sustainable Cities (SSC)[a]	Guide for city leaders Master plan for SSC Stakeholders' engagement in SSC Overview of SSC infrastructure ICT architecture of a SSC Multi-service infrastructure SSC in new-development areas Cybersecurity, data protection and cyber resilience in SSC Intelligent sustainable buildings for SSC Smart water management in cities ICT for climate change adaptation in cities Electromagnetic field (EMF) considerations in SSC Integrated management for SSC Anonymization infrastructure and open data in SSC Key performance indicators definitions for SSC Standardization roadmap for SSC Standardization activities for SSC
The ANSI Network on Smart and Sustainable Cities (ANSSC)	Supports the development and adoption of: – ISO 18091:2014 (quality management systems—guidelines for the application of ISO 9001:2008 in local government) – ISO 37120:2014 (sustainable development of communities —indicators for city services and quality of life)

(continued)

Table 3.11 (continued)

Standard	Specifications and guidelines
NIST IoT-Enabled Smart City Framework Global City Teams Challenge	Application framework: breadth, benefits' and city readiness' measurement Pivotal points of interoperability (PPI): review on existing descriptions and common PPI identification
CEN/CELENEC/ETSI	Development of system standards for smart cities and communities' solutions. Adopted ISO/TC 268 outcomes for: – Smart city definition – Stakeholders definition – Smart city model's definition
BSI PAS 180 Smart City Terminology PAS 181 Smart City Framework Standard PAS 182 Smart City Data Concept Model	– Smart city common terminology and shared understanding – Decision-making framework for smart city leaders – Model for data sharing between different agencies within a city
German DIN/DKE Smart City Standardization Roadmap	Working groups for specifications' definition regarding: – Buildings/construction – Safety and security – Mobility – Smart grid/energy – ICT – Urban processes and organization – Production – Logistics
AENOR Technical Standards	13 projects: – PNE 178101 smart cities. Infrastructures. Metrics for public services networks – PNE 178102 Smart cities. Infrastructures. Multiservice local networks – PNE 178103 Smart cities. Infrastructures. Convergence of management and control systems in a smart city – PNE 178104 Smart cities. Infrastructures. Comprehensive systems for a smart city – PNE 178105 Smart Cities. Infrastructures. Universal access, urban and land use planning – PNE 178106 Smart cities. Infrastructures. Specification guidelines for public buildings – PNE 178201 Smart cities. Definition, requirements and indicators – PNE 178301 Smart cities. Open data – PNE 178303 Smart cities. Management of the city's assets. Specifications – PNE 178302 Smart cities. Interoperability of charging stations. Minimum requirements for the interoperability of electric vehicles recharging infrastructures – PNE 178401 Smart cities. Street lighting. Telecontrol typology according to zoning – PNE 178501 management systems for smart tourist destinations. Requirements – PNE 178502 indicators of smart tourist destinations

(continued)

Table 3.11 (continued)

Standard	Specifications and guidelines
Polish Committee for Standardization (PKN)	PKN task group for smart and sustainable development of cities and communities: collaborates with CEN-CELENECT-ETSI and consists of 2 thematic groups: GT 1-2 on terminology and technical bodies in PKN: collects terms and communicates with stakeholders GT 3 for gathering information and the development and implementation of a work programme: Polish smart city initiatives' information collection
China National IT Standardization TC (NITS)	– Investigation report on status of smart cities and standard needs in China – Draft research report on China standard system on smart cities – Started studying on several standard items on smart cities, such as terminology, reference model, evaluation model etc. – A book—implementation guidance for smart cities

[a]http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

On the other hand, the European standardization organizations CEN/CELENEC/ETSI grounded the Smart and Sustainable Cities and Communities' Coordination Group (SSCC-CG)[52] in order to define a European smart city standard. In this regard, it agreed on the six purposes of sustainability and smartness for cities and communities as proposed by ISO/TC 268 'Sustainable development in communities'[53] and concluded on a report with definitions and requirements (CEN-CENELEC-ETSI 2015). Moreover, it funded a coordination act in 2015 and invited standardization bodies from member states to contribute on a common smart city standard, which considers smart city as a system and it is under development.

The British Standards Institute (BSI) has organized its Smart City Advisory Group and drafted a set of Publicly Available Specifications (PAS) 180, 181 and 182, which define terms and frameworks for decision making and data sharing within a city. From the remainder European States, the German Standards (DIN/DKE) defined a standardization roadmap (DIN/DKE 2014); the Spanish Standards (AENOR) structured the AEN/CTN 178 National Committee on "Smart Cities" on 2012, which has initiated 13 corresponding standardization projects, while it adopted the ISO 37120 document with urban sustainability indicators; and the Polish Standards [Polish Committee for Standardization (PKN)] established the Task Group 1 (GZ 1) on Smart and Sustainable Development in Cities and Communities in 2013, which works on corresponding terminology and requirements definition (CEN-CENELEC-ETSI 2015).

In China, several national standardization committees have started developing smart city standards, including China National IT Standardization TC (NITS),

[52]http://www.cencenelec.eu/standards/Sectors/SmartLiving/smartcities/Pages/SSCC-CG.aspx.

[53]http://www.iso.org/iso/iso_technical_committee?commid=656906.

China National CT Standardization TC, China National Intelligent Transportation System Standardization TC, China National TC on Digital Technique of Intelligent Building and Residence Community of Standardization Administration, China Strategic Alliance of Smart City Industrial Technology Innovation (ISO 2015; CAICT and PDSF 2014).

The above comparison on smart city standards shows that corresponding standardization is still in progress, while different prioritization has been given by the standardization bodies across the globe. At an international level, only smart city definition has been completed, together with city performance indicators and some architectural frameworks, while individual standards are being composed regarding smart city components (e.g., energy, water etc.). In the U.S.A., the focus is on the IoT in smart city and corresponding architecture framework definition, which is being developed simultaneously with competitive projects. Finally, the European bodies are working both at national and supranational levels, in an attempt to define a common European smart city standard that will be adopted by the member States.

Revision Question 1: what does standardization mean?
Revision Question 2: why are standards important to smart city?
Revision Question 3: what is the context of ISO 32170?
Revision Question 4: compare 2 smart city standards.
Revision Question 5: name an important initiative in U.S.A.
Revision Question 6: how do European standardization bodies approach smart city standardization process?

3.4 Smart City Cases in Practice

The previous sections of this chapter showed that an extensive number of cities are - or self-claim to be—smart, while alternative smart services and smart city solutions are being offered according to literature findings or to their official websites. An increasing argument about a "smart utopia" that is led by the joined interest of global high-technology companies and city governments is being documented, which questions what a smart city really is and what its purpose is (Hollands 2008, 2015; Söderström et al. 2014; Watson 2013; Allwinkle and Cruickshank 2011). Even companies like CISCO (2012) consider existing smart city efforts as "utopian" visions, which are dominated by the physical design, resulting in a jumbled mess of engineering and architectural ideas supported by various technologies. Such a utopia could be described as follows (Hollands 2015):

> Imagine life for the citizen of the smart city: you awake in your sustainably built home, and take your morning shower in recycled industrial waste water, cost-efficiently heated overnight. Eating breakfast, you scan the flat screen, fed by maximum bandwidth internet,

> where the special, easy click local neighborhood menu allows you to compare your daily energy use with other houses in the area, confirm your webcam appointment with your doctor, top up the balance of your all-purpose travel card, order your groceries and leave messages for your child's teacher. You can even watch television on it. Outside, your electric car is waiting. On the edge of the central congestion zone, you park in a charging.

Another "futuristic" scenario is written on the hardcover of Widmann (2012):

> Will we drive electric cars made by a printer in the future? Control heating with our mobile phones? Live in cities that are turning into urban heat islands?

In this section, thirteen (13) representative smart city paradigms are demonstrated in an attempt to depict what a smart city really is (Anthopoulos 2017). These exemplars were taken from each of the city classes (existing city, new block/district or city from scratch); many of the smart city classes (broadband, digital, ubiquitous etc.); several city sizes (small, medium and megacity); while they came from almost all continents. Moreover, the case selection was based on the fact that they can be all located in literature and it doesn't mean to exclude or underestimate other existing smart cities.

The demonstration of each case starts from literature evidence, which show what the case supposed to be in theory. Then, its official website was explored during August 2016 with regard to existing official reports about the city and the smart city case, accompanied by references to the offered smart services, which show what really happens or what the city authorities claim that their case is. Both the above evidence could be marketing efforts, blueprints and masterplans or scientific remarks. The narrative tool of a walk within the city (Caprotti 2014) follows, where the city is explored with regard to its size, sustainable performance (e.g., open spaces, sustainable transportation etc.) and smart service accessibility (a Windows CE smartphone, an Android tablet and an iPhone attempted to locate the existence of public Wi-Fi hotspots and location-based services and Apps). Finally, almost all walks were accompanied by an interview with case's officials that took place for the purposes of the EADIC project[54] with an objective to understand deeper the examined smart city case. The interviews were based on free dialogues, which followed a common structured questionnaire defined by the project that aimed to retrieve historical information about the case, the implementation methodology and its current conditions, while their objectivity was based on voice recording and minutes' analysis by the EADIC project team. The identities of the interviewees are left out from this presentation due to privacy concerns.

A walk through the selected 13 smart cities enabled a close look at the reality behind the marketing, blueprints and master plans which present corresponding projects as political, entrepreneurial and technological "responses" against urban challenges. The cases are presented in chronological order of visit, which occurred during mid-2012 and late 2016. Inspired by Caprotti (2014) and by the objectives of EADIC project with regard to smart city's sustainability sources, the following demonstration concludes for each case the following remarks:

[54]Enterprise Architecture for Digital Cities (EADIC)—http://eadic.teithessaly.gr.

a. *Scale*, which summarizes project scope against city's size and helps to make sense of the case over and beyond a limited focus on urban innovation or climate change effects;
b. *Definition*, in terms of describing reality against existing smart city definitions, that have been presented in Chap. 2;
c. *Sustainability*, in terms of summarizing whether each smart city case appears successful in its initially grounded objectives but even more efficient to sustain in time, while city's sustainability is also discussed;
d. *The fringes* of the examined case, in terms of commenting the case and providing with summary about future perspectives or realizing whether a brand-new class of citizens that utilize innovation (e.g., from start-up companies' registration to ease of access to smart services) is growing or that the examined smart city project may change city's capacity against cities' competition (Anthopoulos and Fitsilis 2013).

3.4.1 The Case of Trikala

Trikala is my birth place and the city that I live in. It's a medium-sized city with approximately 80,000 residents located in the center of Greek mainland, in Thessaly region. The first historical evidence for the city come from the 3rd millennium BC, when the ancient city Trikke was founded in today's landscape. Beyond its history, Trikala is famous in Greece for its music and creativity, while it has become an attractive winter touristic destination since it hosts the biggest national Christmas thematic village and several important sightseeing surrounding the city. Local economy is mainly based on agricultural activities and on an increasing creative industry, while local GDP is among the lowest in Greece and in Europe, and the average unemployment rates are approximately equal to the average Greek ones (27% in 2016). A walk in the city validates that Trikala is a typical Greek city, with narrow streets, heavy traffic and both old and new buildings, while several parks and the river of Litheos that crosses the city offer several open spaces. The city has a dense network of pedestrian areas and cycling lanes, it is supported by local bus that mainly connects downtown with surrounded districts and villages, while it has undertaken several initiatives for sustainable mobility (e.g., car parking space release for cycling lanes etc.). *I decided to present the case of smart city of Trikala since it was my initial smart city experience, while at the times of writing I consulate the Mayor with regard to city's further smart city planning and exploitation.*

I was assigned by the mayor of Trikala on August 2003 to utilize my skills and expertise in project planning and management in his attempt to secure funding by the Greek Information Society framework program, which would potentially develop new infrastructure, new jobs and support local economic growth. The Greek Information Society framework program was aligned to the European one *and had access to e-Europe funding. Indeed, I successfully justified a portfolio of 14 projects and a budget of approximately €5 million that addressed several local challenges, ranging from broadband infrastructure installation (a fiber-optic MAN and a metro-WiFi network), to health and care, to transportation, to e-government and to e-business initiatives* etc. (Anthopoulos and Tsoukalas 2006). This portfolio was granted and impressed the Greek national government and labeled it "the First Greek Digital City (e-Trikala)" in December 2004 by government's Ministers and officials in a special event hosted in Trikala. The smart city of Trikala would be implemented with public funding from national and European resources and operate under the ownership of the municipality of Trikala. In this sense, it was a completely public project.

I became case's scientific coordinator right after with duties that ranged from projects' tendering processes initiation; a municipal organization's definition that would manage portfolio's implementation; and further digital city's exploitation in national and international associations that would attract investments and scientific attention. *My contract ended when my above mission was accomplished in late 2005, when I decided not to keep on working for it, since its viability was not secured: I explained that this project was extremely innovative and complex for the municipal resource capacity, while its economic viability was not secure and its future maintenance and exploitation required partnerships with the private sector and the local universities. Infrastructure alone, demanded more than €150,000 annually for networks' operation and maintenance. Moreover, the project had to secure local stakeholders' engagement since by that day, only the local transportation service provider (public bus network) had been engaged. Otherwise, I justified that the project would fail either in sustaining or in meeting its initially grounded objectives for local information society's enhancement and local economic growth*. However, the Mayor did not want to engage the private sector at that time, neither he wanted to engage local stakeholders for political reasons. On the contrary, he demonstrated a strong political willing to implement the projects and to found a new organization in the municipality to operate the project deliverables.

Almost all e-Trikala portfolio's projects were contracted by 2006 and implemented by 2009, while the case had gained its international reputation and joined an initial European project consortium (ISISEMD[55]) in the context of smart care service provision. In 2008, a municipal company named e-Trikala S.A.[56] was founded in association with the local chamber[57]—participates with 1% share—which would be responsible to keep on operating the smart infrastructure and to keep on defining new projects and to develop ICT-related products. However, the lack of resources and of partnership with the private sector and with the local universities, in combination with the national recession in 2009 resulted to project's declining in 2010. More specifically since that year, the smart networks hardly

[55]http://www.isisemd.eu/.

[56]http://e-trikala.gr/.

[57]http://www.trikala-chamber.gr/.

Fig. 3.18 Automatic bus testing bed (CITYMOBIL2 project) (http://www.citymobil2.eu/en/City-activities/Large-Scale-Demonstration/Trikala/)

operate interconnecting public agencies, the intelligent transportation is out of duty, while no smart services are being offered to the local community. The most efficient evidence that shows this failure is that the municipal company was obliged to undertake completely irrelevant tasks, which range from the organization of the annual Christmas thematic event[58] to other types of event hosting in its attempt to afford its individual expenses.

From the initial smart city context, only the participation of the city in several European project consortiums that increased case's budget with an extra amount of €1.3 million has been established—mainly due to case's past success—most of which deal with health-care and mobility. Worth mentioning the participation of the city in the CITYMOBIL2 project (Fig. 3.18), with regard to a fully automated local bus testing and InSMART (Fig. 3.19) with regard to city's energy efficiency modeling and corresponding policy evaluation. From the remainder city utility providers, the water service provider (DEYAT[59]) has installed a telemetering system that monitors 50% of its entire network, while it plans several innovative projects for sewage processing and smart water.

Only a year ago, *I drafted and consulted the Mayor to adopt a Municipal 10 year strategic plan for a Smart and Resilient city, which aims to recover the existing smart projects and focus their utilization for climate change effects: Trikala experience long running heat waves and lasting drought periods, while short but heavy rains turn the local sewage system to their limits*. The strategy works on several dimensions, most of which aim to engage the local community and stakeholders, while its top priority is to enhance internal organization's efficiency and agility in terms of skills, service re-organization and standardization. Its primary innovation concerns the foundation of the Smart City department within the municipal organization, whose authorities concern strategic planning, project

[58]http://www.milosxotikon.gr/home/.

[59]http://www.deyat.gr.

Fig. 3.19 Partners' meeting for the purposes of the project InSMART (http://insmartenergy.com/)

standardization for all city stakeholders and public process re-engineering. This innovation has been selected as a representative best case for the public sector by the European Presidency of Malta in 2017 (Anthopoulos, forthcoming). The strategy has completed its public consultation in June 2016, it has mid-term objectives for 2019 and long-term ones for 2025. Moreover, recently the city became the national representative of the Open and Agile Smart Cities (OASC) city network (Table 2.2).

Scale

In terms of scale, although this case sounds small, it is large for Trikala city's capacity, which addresses significantly the scope and viability of a smart city.

Moreover, despite its public funding, this project had to change its context and secure partnership with both the private sector and the local stakeholders, at least under the contracts' scope. Moreover, the smart city project was complex in most of its terms, which influenced the performance of all deliverables and although all outcomes were implemented, they had never performed optimally and they failed to gain social acceptance, while they could not secure an efficient continuity with the participation of the contractors.

Definition

In terms of definition, the case of Trikala combines smart infrastructure and service deployment across the city. Trikala self-claims to be smart and indeed the smart infrastructure exists; it keeps on operating its corresponding project organization, although its orientation has changed to other directions—irrelevant to a smart city; and participates in several project consortiums. In terms of measuring local intelligence, the indexes of several evaluation models would rank Trikala with a good score for its intelligence, but *my experiences show that smart infrastructure alone cannot secure smart city operation and social acceptance: no smart service is being delivered to the local community*. After more than a decade from its initial conception, the above assets enabled today's smart and resilient city strategic formulation, the foundation of a smart city unit within the municipal organization, the participation in international city coalitions and several awards, which is an attempt to recover and utilize past infrastructure and experience.

Sustainability

E-Trikala after 13 years from its definition has declined—despite its initial strong political support and enough funding—due to a combination of reasons that vary from missing stakeholders' and private sector's interest, to failures in becoming economically viable and socially accepted. Today the case is at a crucial milestone, which questions its continuity: a new strategic plan for Trikala, regarding becoming a smart and resilient city has been adopted by the local government with a timeframe until 2025; a new unit attempts to re-define the role of smart city in Trikala; and several awards have been given again to the city. In case enough funding and stakeholders' engagement will be secured the case might keep on operating, while gaining social interest is a critical challenge. It remains to see, especially under the existing recession conditions and unemployment rates in the area.

Trikala is a green city in terms of environmental sustainability, since it consists of efficient open spaces that secure a green space of 20 m^2/resident in the city. Several initiatives have been undertaken since 2012 that deal with pedestrian areas' and cycling lanes' extension, while several parking spaces have been released from downtown as some of municipal measures to encourage sustainable mobility in the city. However, climate change adaptation is another challenge that the city faces and plans corresponding project interventions.

The fringes

Trikala city is a personal experience and some evidence exists in literature (e.g., Anthopoulos and Tsoukalas 2006) *that describe the "rise and fall" of a smart city*. Trikala is a representative small-scale project, which enhanced smart infrastructure in its attempt to become a smart city as it self-claims to be. However, failures in terms of project sustainability and social acceptance have brought the case to a critical milestone, which questions its future. The experience of Trikala shows that a smart city project must first realize its potential, define realistic outcomes, secure economic viability and engage local stakeholders in order to gain social acceptance. Strong political willing by the local government and funding existence alone, cannot ensure project success, especially in a long-term view.

3.4.2 The Case of Tampere

The smart city of Tampere (e-Tampere) in Finland is an old case, which was launched in 2001 as a 5-year development project (Viteli 2005). One of the core objectives of e-Tampere was to transform the city as the leading Information Society's developer in Finland, while the three main themes of e-Tampere were to develop public online services; to setup a knowledge base for research and training; and to encourage new business registration in the digital economy.

This smart city case was supervised by the city of Tampere[60] in partnership with the University of Tampere and it initially utilized European funding coming from the e-Europe framework programs, which concern the implementation of the European strategy for an Information Society (Anthopoulos and Fitsilis 2014). The case of Tampere structured a project portfolio, which consisted of the following interventions (Viteli 2005):

- Information Society Institute (ISI) at the University of Tampere;
- eBusiness Research Centre (eBRC) to promote e-business related research;
- Research and Evaluation Laboratory (RELab) to operate as a testing environment for smart solutions;
- eAccelerator as a business incubator that would result to a 20-new company registration in the digital economy;
- Technology engine programs that would enhance software development in collaboration with the local universities;
- Infocity, which was a project portfolio for online public service delivery;
- eTampere office, which was the corresponding project management office at the city of Tampere.

However, except from this evidence, the smart city of Tampere suddenly disappeared from literature and it appeared again in 2011. According to Ergazakis et al.

[60]https://www.e-tampere.fi/english/.

(2011), the smart city case increased Internet household penetration to a 72% and online public service use to a 50%, while more importantly it created a cluster of 20 new companies working for the digital economy, as an attempt to decrease local unemployment rate to a 5%. Today, the smart city of Tampere[61] appears to have entered a new era with a new smart city definition named Smart Tampere (City of Tampere 2014), according which the city has moved towards 2 directions:

1. The development of a new district Vuores[62] with sustainable planning principles; the renovation of city's center,[63] of Tesoma[64] district and of Kauppi campus in an attempt to enhance its sustainability and to attract new residents by 2030;
2. The implementation of several smart city interventions, which range from *city's open innovation platforms* that enhance creativity and learning; *open data*[65] launch; *service digitization*; *health* technology of the future; and *industrial Internet*.

A query can be raised regarding what had really happened after e-Tampere's project completion in 2005 and until today's smart city conception. In this respect and for the purposes of the project EADIC, *I made a contact with the project's responsible scholar from University of Tampere* on April 2012, requesting an appointment with him during my forthcoming visit to Tampere (*I was going to attend an Erasmus meeting-IP Virrat*[66] hosted by the University of Applied Sciences of Tampere—in nearby town Virrat on late April 2012). *In his response, he confirmed that the project had ended in 2005 and it wasn't running anymore, while he forwarded my request for an appointment to the director of Tampere city's development. Thankfully, the director accepted my request and arranged a meeting on April 25, 2012 at his office at the City of Tampere Administrative Building, located at city's downtown*.

I arrived in Tampere that day's morning, when my colleagues left me with their car to city's railway station. The meeting had been arranged to take place at the afternoon so I walked directly to the meeting venue. Although it was spring, the weather was quite cool and the city lakes were still frozen but they had started melting, generating water flows in city's canals, which operates as a renewable energy source. The city looked like a typical European medium-sized one, of approximately 200,000 residents, with historical characteristics, open spaces and large sidewalks (Figs. 3.20 and 3.21). *Sustainable mobility was encouraged in city's downtown, since car parking spaces had been released and a network of local buses*

[61]https://yritystampere.fi/en/smart/smart-city.

[62]https://vuores.fi/.

[63]http://www.tampere.fi/tampereen-kaupunki/projektit/kaupunkiymparisto/keskustahanke/keskustan-kehittamisohjelma.html.

[64]http://omatesoma.fi/.

[65]http://www.tampere.fi/tampereen-kaupunki/tietoa-tampereesta/avoin-data.html.

[66]http://ip.projects.tamk.fi/digisomemarit/.

Fig. 3.20 A representative view of Tampere

Fig. 3.21 Tampere open spaces

enabled citizen trips in the city. Moreover, the city has a railway station and a local airport, while it's the capital of Tampere region, which hosts among others the town of Nokia, the birthplace of the well-known telecommunication company.

During my walk to the meeting venue I performed a brief investigation regarding potential smart service availability in the city: I checked on my smartphone for the availability of public Wi-Fi hotspots and I discovered several accessible and open wireless networks, which were hosted by alternative providers (e.g., by the bus transportation provider). Moreover, I saw that the local buses' network was supported by an intelligent transportation system.

The meeting started on-time and lasted about an hour. *The director told me the story of e-Tampere, whose purpose was not to create a smart city but to develop a network of stakeholders (mainly with the local universities) that could enhance the city's information society potential in terms of e-service development and diffusion, Internet penetration and job development in the digital economy. He claimed that* *the project portfolio did not aim to deploy smart infrastructure in the city and the Municipality had engaged local stakeholders (e.g., the bus operator; the energy provider; telecommunications provider* etc.*) to become familiar of the e-Tampere case, while it encouraged them to deploy their individual smart infrastructure projects. According to his sayings*, the budget of e-Tampere portfolio was approximately €5 million and managed to develop the above organization units in partnership with the local universities. *He also mentioned that the above interventions resulted to an efficient number of approximately 1000 freelancers working that period for the digital economy and hosted in e-Tampere offices, which were able to develop several software products and e-services. Finally, he claimed that the city was not willing to keep on operating the resulted organization units if they would fail to remain viable in economic terms*, which shows that project deliverables operated independently, despite they had Municipality's support.

Scale

In terms of scale, this case was small in its beginning with a realistic budget and scope. E-Tampere is a completely different smart city compared to the remainder cases. Although its purpose was not the development of a smart city in terms of smart infrastructure and smart service deployment, it addressed and succeeded in 2 smart city dimensions: smart people—in terms of growing a knowledge community and utilizing local universities on common targets—and smart economy—in terms of growing the digital economy and creating new jobs. *I realized that e-Tampere after 11 years of initial completion, it had established a dedicated partnership with the local universities, which could enhance future smart city development*. Indeed, today Tampere entered a new smart city era, with several large-scale projects and updated priorities.

Definition

Tampere did not self-claim to be smart, neither its project's definition concerned the development of a smart city until recently. According to the literature evidence and the meeting's outcomes, the case of Tampere aimed to create a community that would be able to enhance local smart potentials: the development of smart products and services; and new jobs' creation in the digital economy. These 2 achievements in partnership with the local universities concern smart people and smart economy dimensions respectively, which validate that it is a smart city. Moreover, *my experiences and official website show that smart infrastructure exists in the city (e.g., Wi-Fi hotspots) and smart services are available (e.g., smart transportation and e-government services)*. The above assets enabled today's ambitious Tampere smart city project, which consists of an updated project portfolio with both construction and smart projects.

Sustainability

E-Tampere was at its 11th year after its conception and had closed its initial project timeframe in 2005. However, project deliverables were still operational and a community of an efficient number of freelancers in the digital economy was setup. Several corresponding projects were under construction by this community and this approach looked quite sustainable that day. The smart city of Tampere utilized these outcomes, it still exists today and has entered a new smart city era, *which validate my past feeling*.

Moreover, the city of Tampere had engaged several stakeholders in deploying their smart infrastructures and services, avoiding taking the risk of deploying individual smart projects, while today it utilizes past outcomes as open innovation platforms. Finally, in terms of environmental sustainability, open spaces and sustainable mobility had already been adopted, while today's new district constructions and areas' renovation address environmental sustainability.

The fringes

Although there's a lack in literature evidence about the smart city of Tampere and the city did not self-claim to be smart, my experience shows that it's a successful story, which started from the fundamentals: a city can be considered smart when its people are smart and in this respect, it started with the development of efficient organizations that would enhance people's intelligence and create new jobs. After 11 years from its conception the project outcomes were there, and today they evolve further. Finally, the city follows sustainable planning, while it engaged local stakeholders in implementing projects relative to the smart city nexus. This project organization is different compared to the remainder case studies, since a partnership with the university resulted to several organization units for future smart city developments, while the local stakeholders were encouraged to implement their individual smart projects too.

3.4.3 The Case of Geneva

Geneva is one of the first smart city cases that appears in literature (Van Bastelaer 1998), since the local Metropolitan Area Network (MAN) entitled Geneva-MAN was launched in 1994. This network started as a pilot project with the strong support of local government and Swiss Telecom that interconnected the international organizations in the area but progressively engaged several local stakeholders. This case was presented by the local government during an ITU meeting in 1996[67] and became popular right after. Another case entitled "Smart Geneva" was mentioned by Van Bastelaer (1998), as an attempt to economically utilize the Geneva-MAN, which was waiting for operational decisions. Van Bastelaer (1998) closes the discussion mentioning a non-operational project, which faced several complexities like project's viability in terms of clients' identification and technical support.

[67]http://www.unige.ch/gva-man/segond.html.

No more literature evidence about Geneva-MAN or a corresponding smart city project for Geneva can be located, which questions its continuity. Instead, another pioneering telecommunications network is being referred, developed by Swissquantum in 2011, which is the longest running project for testing Quantum Key Distribution (QKD) in a field environment.[68] This network serves as a platform for: Research & Development (R&D); demonstration; and education all in the field of quantum communications. Moreover, some evidence can be found regarding the "Strategic Programme for Sustainable Development 2011–2014" (City of Geneva 2010) that has been implemented as part of city's obligations to Aalborg Commitments.[69] Today, the local government implements the "Service Agenda 21 Ville Durable", which is a municipal program that aims to enhance local sustainability in terms of environmental protection, equity, local economic growth and citizen engagement (City of Geneva 2014). This program contains several innovative activities but, they do not name them smart.

Geneva is the "smallest of big cities" with a population of 200,000 inhabitants, an international city, where more than 20 international organizations (e.g., United Nations, ITU (Fig. 3.23) etc.) are located and more than 160 other countries' permanent missions also have offices there, it has a strong and attractive local economy,[70] while it is one of the greenest European cities. The official city's website[71] provides residents, visitors and businesses with local information, but with no particular references to smart city initiatives. The only corresponding references can be located on the local energy provider, which is a public institution named Services Industriels de Genève (LSIG) or SIG.[72] In his official website information is available regarding its fiber-optic network[73] and its contribution to city's energy efficiency.

I visited first time Geneva on August 30th, 2013 after my hard efforts to locate and arrange a meeting with the appropriate person to discuss about Geneva MAN and about other smart Geneva initiatives. My interviewee was the head of telecommunications (director) of SIG (I leave his identity out for privacy concerns). I arrived that day morning at the local airport and accessing downtown was an extremely easy process with a direct and free-of-charge train connection. I walked to my hotel that was right beside the train station, which provided me with a free-of-charge ticket to use public transportation (buses and trams) during my staying. My initial feeling was that Geneva was the most accessible city I've ever visited, which encourages you to use sustainable mobility of public transportation from the beginning.

Since my appointment was at this day's noon, I walked directly from Place de Cornavin to the nearest bus station (Fig. 3.22), *which took me to the SIG district*

[68] http://swissquantum.idquantique.com/.

[69] http://www.sustainablecities.eu/aalborg-process/commitments.

[70] http://www.geneve-finance.ch/en-ch/index.cfm.

[71] http://www.ville-geneve.ch/.

[72] http://www.sig-ge.ch/en.

[73] https://www.sig-fibreoptique.ch/.

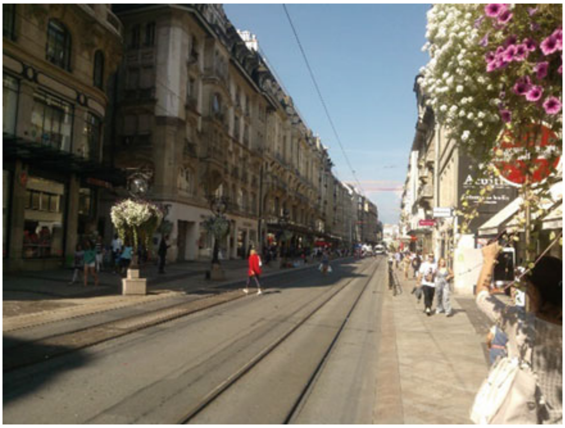


Fig. 3.22 Representative view of Geneva transportation

located at city's borders. Bus stations were equipped with smart signs showing estimated arrival and departure times. Bus line 9 s trip lasted about 20 min, I arrived on time and our meeting lasted approximately 2 h. The director explained me the story of Geneva MAN, together with SIG plans for fiber-optic network's deployment with a Fiber-to-the-Home (FTTH) and Fiber-to-the-Business (FTTB) schemas (Fig. 3.23).

Scale

The director explained me that SIG is a public organization that operates under Geneva Canton, it is responsible for energy, gas and heat provision to Geneva area and has undertaken the deployment of the Fiber-Optic Network to the entire city (FTTH and FTTB). SIG occupies approximately 1200 employees, while the director supervises a team of 40 people.

Definition

In terms of definition, the case of Geneva was mainly based on a fiber-optic network (Geneva-MAN), while several other smart services have been deployed by

Fig. 3.23 ITU headquarters in Geneva

utility providers (e.g., smart transportation by transportation service provider). Geneva MAN was a pilot project that was envisioned in 1994 and its installation was completed in 2003. It served with 100 MBps speeds a small urban area, it was free-of-charge and offered VoIP and TV services. However, only 50% of the end-users agreed to connect to this network, although the legal framework obliged SIG not to charge citizens, but only businesses. On the other hand, local companies expressed their interest to this network, they connected their facilities and a business-broadband sub-network was successfully installed.

Sustainability

The project was abandoned in 2005 since it failed to gain social acceptance and to interconnect households, and only a smaller network remained that connected local enterprises. It restarted in 2008 with a vision to connect all the local households and enterprises in Geneva. On May 2009, SIG board allocated a budget of 200 MCHF [million Swiss francs (CHF)] on this project and authorized the installation of this network and the foundation of SWISS Fibre Net.[74] The network would operate under the responsibility of SIG, while SWISS Telecoms (the National Telecommunications Provider) will be responsible for its operation and offer voice, data and content services, as well as mobile communications in cooperation with Orange Telecoms (national Mobile Operator). In this order, a fiber-optic wired network is being deployed, accompanied by the appropriate wireless network. Moreover, this network will be combined with smart-grids, in order to optimize energy efficiency in Geneva.

Although the initial project failed in terms of sustainability, SIG is committed to implement it and deploy energy efficient services simultaneously. This extended to FTTH Geneva MAN is part of the "Strategic Programme for Sustainable Development 2011–2014" (City of Geneva 2010), which has been defined by the Municipality of Geneva, while it is guided by a business plan composed by the SIG. The business plan estimated project completion in 2015, it contains a marketing plan of 1 MCHF, while it defines the "Network" business model as a means to establish a return-of-investment in a 20-year period. Additionally, this network was planned to enable an "Energy Savings Market", which offers great opportunities to both the SIG and the city. Moreover, FTTH Geneva MAN follows open-access architecture and enables various stakeholders to rent it.

In terms of city's sustainability, the city of Geneva is a green city with open spaces and sustainable transportation. Moreover, the city has signed the Aalborg commitments, planned and followed a corresponding strategic plan 2011–2014, which today has been updated to Service Agenda 21.[75]

---

[74] http://www.swissfibrenet.ch/.

[75] http://www.ville-geneve.ch/administration-municipale/departement-finances-logement/services-municipaux/service-agenda-21-ville-durable/.

The fringes

Geneva MAN is a complex and large-scale project that passed through various phases during its life-cycle, among which a 3-year failure of gaining social acceptance, which stopped the project. Businesses appear more likely to use fiber-optic services compared to households. These findings confirm that public smart city projects may not be well-defined in their initiation, while they cannot secure social adoption although they might deliver free-of-charge services to the citizens. Geneva MAN's updated case appeared better managed project (both in strategic and project forms), with the involvement of many stakeholders (public, state and private), where a business plan and a clear project definition were documented.

3.4.4 The Case of Seoul

Seoul is an existing city and one of the world's megacities. City's smart strategy and corresponding initiatives are planned and managed by the Seoul Metropolitan Government (SMG).[76] Its intelligent transportation system is entitled Transport Operation and Information Service (TOPIS), it is controlled by a tower and collects and processes real-time road and subway traffic (Cities Alliance 2015). TOPIS has gained customer satisfaction, but its implementation addressed stakeholders' opposition (bus companies and street vendors) and missed cooperation with open and continuous dialogues, while corresponding regulation required updates.

Transportation service in Seoul has been enhanced with the "Owl Bus", which is an innovative late-night bus service and has made trips cheaper and safer for city residents. This project is based on big data analytics, it engaged the SMG, a local telecommunication firm (KT) and residents in order to identify areas of the city that saw the most call volume during the hours from 1 to 5 am, and developed the routes accordingly (Cities Alliance 2014).

According to the official SMG website, several policies are being implemented under the umbrella plan "Seoul Master Plan 2030" (SMG 2010; An and Kim 2015), which concern health and welfare (shelter finding, women safety and ageing support); employment (economy); urban planning (Seoul International Complex; park development); city branding (I Seoul U); and social cohesion (worker rights' support). With regard to smart service deployment, SMG -in partnership with several ICT companies—(Lee et al. 2014) is committed to publishing open data[77]; it offers real time traffic and air quality data; and important information for visitors, residents and businesses. Moreover, SMG has undertaken a 4-year plan for 2018, which consists of 139 projects for developing a "Safe, Warm, Dreaming, and Breathing City" as well as a "Pedestrian-Friendly City".

---

[76] http://english.seoul.go.kr/.

[77] http://data.seoul.go.kr/.

Fig. 3.24 A view of the Gangnam-gu district

My journey into Seoul ubiquitous eco-city begins from Gangnam-gu district, a winter morning of February 2014. Flagship eco-city and u-city projects were being built across the globe and several were already in advanced stages at the time of visiting. These include Masdar in Abu Dhabi (Cugurullo 2013), Tianjin Eco-City in China, and Songdo eco-city in South Korea (Kim 2010; Shwayri 2013). Gangnam-gu self-claimed to be a ubiquitous district in this year, after the implementation of a 5-year e-government plan,[78] which would result to an App for sophistication of smart administration in 2013; personalized 24/7 civil service; and a "u-Gangnam City Control Center".

The weather was cold and *I had both to walk and to use the subway to access the city hall, the Namsangol Hanok Village and the overall Myeong-Dong district. The first thing that I tried to verify was whether a city Wi-Fi network existed, as well as subway routes information, but both were not available. So, I asked the reception of my hotel for a printed map and for some directions and proceeded to the closest subway station (Gangnam).*

Coming from Greece where cities lack in open spaces, but familiar with smart city projects, *I walked on really large sidewals beside 6 lanes streets* (Fig. 3.24) *and I accessed really crowdie subway stations, which validate the existing policy requirement for a pedestrian-friendly city. I had plenty of time, so I used my Windows CE-based smartphone and a second device with Android operating system (OS) for location-based services and apps, but no city-owned one was available at that time, neither for Gangnam district nor for Seoul in general. I was wondering about the requirement and feasibility of a ubiquitous city, while I was watching the traffic and the mostly brand-new buildings across the Teheran-ro, while old ones were hidden behind the skyscrapers*.

[78]http://www.koreaittimes.com/story/20769/smart-city-gangnam-gu%E2%80%99s-e-government-strategy.

I had in my mind to locate smart signs for public buses that would display the estimated arrival and departure times but they were not available and people were waiting at bus-stops, patiently in queues for bus arrival instead (Fig. 3.25). *However, such signs existed in metro stations, where access to Wi-Fi hotspots was available, but they were not open for visitors' use*. Only if someone owned a cellphone number hosted by a national operator could access them and someone could observe the residents to use smartphones for enjoying web-TV and other services, both at the stations and during their the subway trips. *I was impressed of the ticketing system, which issued and validated tickets rapidly, charging the traveler according to the destination trip*. Locating stations and directions was an easy process, regardless the local language, since all signs were available in English too.

After arriving at the Myeong-Dong district, I realized that SMG had emphasized on open space creation, like the one at the city hall (Figs. 3.26 and 3.27). *I looked*

Fig. 3.25 People waiting for the buses in queues

Fig. 3.26 A representative open space at the city hall

Fig. 3.27 A representative view of Myeong-Dong district

around for intelligent transportation signs and for location-based Apps and Wi-Fi at my mobile devices with again no luck, even within the nearby Lotte mall. Similarly, I accessed the Seoul central railway station (Fig. 3.28)*, where cutting-edge screen displays offered access to advertisements and train trips, but almost all*

Fig. 3.28 A representative view of Seoul central railway station

people used the traditional queues to issue their tickets instead of using online ticketing or check-in systems.

This urban walk through Seoul city works well as an entry point into analyzing the trends of rapid urbanization, economic "race" and environmental change, which the eco-city projects are meant to mitigate and adapt to. In this sense, Seoul ubiquitous Eco-City can be considered within the context of an "explosive character of growth" (Caprotti 2014) as a means to compete against the opening up of neighbor China's economy to the forces of globalization and international capital flows, which has seen the economy, nature, and the city intertwine in ever more fluid and changing iterations.

Scale

After all this experience, when considering scale, *I realized that embedding smart technologies and launching smart services in such a big city requires time, that could last for more than a decade*. On the other hand, urban planning in Seoul can utilize open spaces, free car lanes from big avenues for sidewalks or for bus use, as the SMG claims.

Definition

With regard to definition, as a visitor *I really did not feel like walking in a ubiquitous nor an ecological friendly environment and in this respect, there are many things left to be done in Seoul*. In ecological terms though, empty spaces exist but the extensive size of old buildings and of the city in general and the traffic size require many interventions for waste and emission control.

Sustainability

I saw people of all ages using mobile technology in trains, which shows that smart technologies can easily sustain within the city. I also saw a "dedicated" Asian community offering social services, which leaves space for eco-friendly living adoption (e.g., walking, recycling etc.). However, the city size and existing facility does not leave enough space for other interventions (e.g., cycling lanes, heating network etc.). In the case of Seoul, it was clear to me that the question of constructing sustainability it was conceptualized at a high level, which is proven by existing planning.

The fringes

Most Koreans have adopted smart technology and in this sense they can enjoy the smart services. Poverty exists though in Seoul, which can generate a technological divide due to parts of community's inability to access technology and corresponding opportunities (e.g., data economy). Personally *I did not feel that technology itself can support Seoul in the international city arena*. City's size and facilities (e.g., Incheon airport, harbor, local businesses and universities etc.) are its competitive advantages that are expected to support the city sustain against Asian-Pacific competition coming from rising China, Japan, Singapore etc.

3.4.5 The Case of New Songdo

New Songdo [or Songdo International Business District (IBD)[79]] is known as the South Korean smart city flagship and part of a broader national ubiquitous city program that involves the development of 6 ubiquitous cities in South Korea and the development of a u-city center at the National Information Society Agency (NIA 2007). It is a district from scratch,[80] developed on reclaimed wetland from the Yellow Sea, covering an area of 48.26 km^2 and very close to the city of Seoul. This project is one of the most famous around the world, since a lot of videos[81] have been shared by its developers (Gale International, POSCO and CISCO). Other contractors were LG, Microsoft, 3M, United Technologies (UTC), and the architects of Kohn Pedersen Fox (KPF).[82] It was a mega project-initiated back in late 1970s as a landfill construction and updated in 2003 as a city from scratch—with a budget that exceeded the amount of $38 U.S. billion, funded as a Public Private Partnership (PPP); with a schedule to complete by 2011; with the involvement of Incheon Metropolitan City[83] on behalf of the public sector; it applies several business models, but mainly is a real-estate project; it aims to host more than 300,000 residents (during a working day) and operate as an international city, a free economic zone[84] and an aerotropolis (a Western-oriented city more focused on the airport and China beyond than on Seoul); it is a green city (it follows LEED standard and produces less than a third of greenhouse gases (GHG) of a typical metropolis of that size); it is a sustainable city, designed optimally to offer walking-distance accessibility to its residents for their daily needs (access to school, mall, welfare, stations, parks etc.); it is a smart city with interconnected each square inch, teleconference and tele-presence services; where a new “city as a service” model is being developed by CISCO, bundling urban necessities—water, power, traffic, telephony—into a single, Internet-enabled utility, taking a little extra off the top of every resident’s bill.

Moreover, beyond being a ubiquitous city project, it has been also labeled a “City in A Box”,[85] which can be exported as a product overseas. Indeed, the South Korean construction company POSCO has undertaken the master planning of several corresponding city projects (Hanoi and Splendora in Vietnam; and Koyankus in Kazakhstan) (POSCO 2015). The official website of the city offers useful information for residents, visitors and businesses, while the website of the project presents the master plan and corresponding ubiquitous and green technologies.

---

[79] http://songdoibd.com/.

[80] http://www.fastcompany.com/1514547/ciscos-big-bet-new-songdo-creating-cities-scratch.

[81] https://www.youtube.com/watch?v=fHO_zkHPTaI.

[82] http://www.kpf.com/projects/new-songdo-city.

[83] http://english.incheon.go.kr/index.do.

[84] http://www.ifez.go.kr/.

[85] http://archis.org/publications/volume-34-city-in-a-box/.

I had arranged an appointment and interview with a top-level manager (I leave his identity out for privacy purposes) *from Gale International on Wednesday, February 19th, 2014 at 10:30 am at Songdo's Sheraton Hotel. All the above information that I had collected and studied, had provided me with extremely high expectations regarding the size and performance of this city from-scratch. I used both the subway and a taxi to get from Gangnam-gu district to New Songdo and the trip lasted about 1 h and a half, since Songdo is closer to the airport than to the city of Seoul. I arrived earlier so I had time to check my portable devices for the metro Wi-Fi installed by CISCO, but none was not available, neither location based services, which created me a sense of disappointment. I did not even see any cutting-edge technology installed in the urban space (e.g., intelligent transportation screens or other touch screens or services). I only experienced tall, brand new buildings, streets with 4–6 lanes but empty of cars and in general a "peaceful" city, which was still under development* (Figs. 3.29 and 3.30).

Fig. 3.29 A representative view of Songdo Hotel Sheraton

Fig. 3.30 A representative view of Songdo under-construction sites

Fig. 3.31 A representative view of Songdo school

Fig. 3.32 A representative view of Songdo mall

Gale's representative arrived on time and we had about an hour discussion regarding the project's context. He explained me the particularities of this project, its scope, its stakeholders (Incheon city and private partners), the complexities and the role of Gale International. Then he drove me around the city [from Sheraton, to the school (Fig. 3.31), then to the mall (Fig. 3.32), to the golf park (Fig. 3.33) and to the city borders, where Samsung operates a plant that remotely collects over a pipes' network garbage directly from buildings, processes it and returns energy and heating water to the city[86]]. *He explained the sustainable planning of the district's center, around which the South Koreans were building with a different style and a less sustainable urban planning, a result that generates different neighborhoods* [*ones with American* (Fig. 3.34) *and ones with Korean design* (Fig. 3.35)]. *He*

[86] http://www.bbc.com/news/technology-23757738.

Fig. 3.33 A representative view of Songdo Golf center

Fig. 3.34 A representative view of U.S. building design and city planning

Fig. 3.35 A representative view of Korean building design and city planning

looked quite skeptical regarding the project's sustainable future and this fact shows that different perspectives and interests were "struggling" during the project, which can be also confirmed by Shwayri (2013), who claims that the local government was disappointed by Gale's failure in attracting foreign investments.

Scale

In terms of scale this project is impressive, especially if you think that this landscape was a sea in the past. However, it gave me the sense that it was still under construction and that it would remain under construction for long, since the Korean companies were developing several districts that do not follow the same architectural and urban planning standards.

Definition

This visit and interview confirmed that technology and especially the ICT alone, is only a small part of the smart city system. *I realized that even in a smart or green city from-scratch competitive interests struggle that come from different stakeholders* (e.g., U.S. contractors designed the exemplar following the initially grounded requirements for sustainability, while Korean contractors prioritize economic performance and violate these standards). *Moreover, I did not experience smart services at all, which proves that it's only a small part of the business. The primary role of Songdo is to become an international district and an aerotropolis, which will be accessible by international residents and businesses.* Indeed, several universities from overseas have developed their own campuses in Songdo.[87]

Sustainability

The city was peaceful, without traffic, while even the subway station that I used to return back to Seoul was empty too. I can't tell whether Songdo is or if it will remain sustainable. A part of the city followed extreme standards for sustainability and expects new residents to buy apartments and relocate. According to my interviewed expert, a population of 600,000 residents were expected to live in the city in 2016. *I can't tell if this objective has been achieved. I felt, that this was the best-case scenario of their business model*, since the Korean companies had already differentiated their design and planning style, a fact that showed a realistic change, while several sites looked quite declined and that they required maintenance (Figs. 3.31 and 3.36). Nevertheless, *I was impressed of the smart garbage plant, which showed me the future of the rising green economy and generates new perspectives for Songdo's sustainability*. I can validate open spaces, sustainable buildings and mobility, and smart waste management, which were claimed to be the main principles that Songdo adopted as a green city paradigm.

[87]http://blogs.wsj.com/korearealtime/2011/07/14/songdo-suny/.

Fig. 3.36 Songdo branding of the tomorrow city

The fringes

Songdo gave me the sense of the primary role that marketing plays in the smart city arena. Videos and articles about Songdo had generated great expectations to me, most of which I did not meet during my visit. However, it seems that this marketing scored for the primary contractors, since they have already secured similar projects overseas. Politics played significant role for the development of Songdo case, with regard to South Korean efforts to sustain against the opening Chinese and other neighbor countries' economies. *My visit showed me that a city from-scratch is not necessarily smart—since I did not access any ubiquitous smart services—but, it is easier to follow sustainable planning standards and to install large-scale facilities for smart service provision, compared to existing cities (e.g., even for the city of Seoul). In the end, I would agree with* Shwayri (2013), who claims about Songdo that "Though not yet completed and thus too early to determine success, the current physical, political, and economic developments are indicative of the expected final form and function of this new city".

3.4.6 The Case of Vienna

The Smart City Vienna project[88] was launched in 2011 (Madreiter and Haunold 2012) after engaging local stakeholders and addressing corresponding fields of knowledge. The primary literature evidence is by Cohen (2012) who placed Vienna 1st among the compared cities, with the use of rankings from Innovation Cities Top 100 Index[89] (5th innovative city); Mercer's Quality of Life Index[90] (1st with regard

[88] https://smartcity.wien.gv.at/site/en/.

[89] http://www.innovation-cities.com/indexes.

[90] http://www.mercer.com/newsroom/western-european-cities-top-quality-of-living-ranking-mercer.html#city-rankings.

to quality of life); Siemens regional rankings of green cities[91] (4th green city); the digital city rankings of Digital Community[92] combined with the IDC rankings of smart cities in Spain[93] and Rutgers's digital governance in municipalities worldwide study[94] (8th with regard to digital governance performance). The Smart City Vienna's consortium is structured by several local and scientific partners, led by the Municipal Department 18—Urban Development and Planning with the support of TINA VIENNA[95] Urban Technologies and Strategies GmbH municipal company (Project Management) and the Municipal Department 20—Energy Planning.

The case was founded by 3 forums' outcomes (Madreiter and Haunold 2012): The Smart Energy Vision 2050, a long-term vision for city's energy future; the roadmap for 2020 with mid-term energy targets; and the Action plan for 2012–2015, which determined short-term measures. These documents led to the Smart City Wien Strategy (Vienna City Administration 2014), while they outline that Vienna's smart city project prioritized local energy efficiency and more specifically, the strategy aims to reduce energy consumption by a 40% until 2050; to increase renewables from 10 to 50%; to minimize motorized transportation from 29% to less than 15%; ant to maintain green space at 50% of the entire landscape (Gaiddon et al. 2016).

The initial project portfolio[96] consisted of the *Innospirit* for urban technology enhancement; the *CLUE* for climate neutral and resource-conserving urban district development; and the *Transform* with regard to low carbon city transformation. Today, several projects are being implemented,[97] which deal with Education and Research; Health and Social Services; Building Activity and Living; Transportation and Urban Planning; Environment and Climate Protection; People and Society; and Politics and Administration/ICT. This project portfolio addresses several local challenges that deal with most of the smart city dimensions.

Beyond this portfolio, Vienna is engaged in the Smarter Together EU Lighthouse Project, according which (Gaiddon et al. 2016) a post-industrial district (Simmering) will be renovated and adopt smart city eco-efficient and sustainable principles. Moreover, the Seestadt Aspern[98] is being constructed from-scratch on a land of 240 ha, as a large-scale smart city and eco-efficient district (He et al. 2015; Siemens 2015). The official city's website[99] provides residents, visitors and

[91] https://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/gci_report_summary.pdf.

[92] http://www.govtech.com/dc/digital-cities/.

[93] http://www.portalidc.com/resources/white_papers/IDC_Smart_City_Analysis_Spain_EN.pdf.

[94] https://spaa.newark.rutgers.edu/sites/default/files/files/EGov/Publications/Digital-Governance-Municipalities-Worldwide-2014.pdf.

[95] http://www.tinavienna.at/.

[96] http://ww2.tinavienna.at/en/referenceprojects/smartcity.

[97] https://smartcity.wien.gv.at/site/en/projekte/.

[98] https://smartcity.wien.gv.at/site/en/projekte/bildung-forschung/smart-cities-demo-aspern-scda/.

[99] https://www.wien.gv.at/english/.

businesses with useful information about urban planning, local government's policies (e.g., for welfare, equity and sustainable living), activities and services, while open datasets are being offered via it data portal.[100]

I visited Vienna on early April 2014, after arranging a meeting with Smart City Wien Agency for the purposes of the EADIC project. Since I was not aware of case's context, I had applied to TINA Vienna for this meeting, but the meeting request was forwarded to the Project Manager of Smart City Wien, Head of Municipal Department 18-Urban Development and Planning. The meeting was arranged in the morning of April 4, 2014 at the municipal offices of Smart City Vienna.

It was my second visit in Vienna under a smart city context. My first had taken place in 2003 when I was the scientific coordinator of Smart City Trikala, Greece and I had met the officials of Austria Telecom[101] *to experience their fiber optic networks that they were being installed in Vienna that period. Accessing Vienna downtown from the airport was an extremely simple process,* via *the direct train connection, while moving to my hotel beside Danube river was simple too* via *an efficient subway network. Vienna is a typical historical European city, with an impressive old downtown and a dense network of pedestrian areas and cycling paths, and an efficient public transportation network of trams and a subway. It's a city that has followed a sustainable urban planning framework and consists of lots of open spaces and parks, while car avoidance is extremely encouraging.*

I began my trip to the municipal offices in the morning of April 4th. I used the subway, which is fully supported by intelligent signs informing you of the departure and arrival times and equipped with an effective ticketing system. I also noticed that intelligent transportation supports most of the tram stations located downtown. I tried and located several public Wi-Fi hotspots[102] *during my trip and location-based Apps on my portable devices (Handy Parken: guide for parking space location*[103] *and Qando Wien: city guide*[104]*).* Today, more mobile Apps are also available, like Car2Go[105] car-sharing service and Uber[106] driver locating service. *The subway train took me directly to Schottentor station, nearby the meeting venue* (Figs. 3.37 and 3.38)*, outside of which I noticed posters mentioning the Wien 2025 strategy and digital signs demonstrating city's energy consumption. Both of them reminded me the official website's reports for city' energy efficiency. My meeting with the officials (I leave their identities out for privacy concerns) started on time, it lasted about 1 h, while I had the chance to realize the role of project management office and the corresponding activities.*

---

[100] https://open.wien.gv.at/site/open-data/.

[101] http://www.telekomaustria.com/.

[102] https://www.wien.gv.at/english/administration/ict/wlan/.

[103] https://play.google.com/store/apps/details?id=at.mobilkom.android.handyparken.

[104] https://play.google.com/store/apps/details?id=com.fluidtime.qando.

[105] https://www.car2go.com/AT/en/wien/.

[106] https://play.google.com/store/apps/details?id=com.ubercab.

Fig. 3.37 Smart city Vienna's project manager offices

Fig. 3.38 The entrance of the venue

Scale

Smart City Vienna is a well-managed smart city case that involves a distributed project portfolio, which follows specific standards. The city government is associated with local stakeholders and structured a project consortium for separated *projects that align to common strategic objectives. The role of the project management office was to define specific guidelines and rules for all city stakeholders in their corresponding smart city initiatives* (e.g., Austria Telecom—Wi-Fi deployment; transportation service providers'—intelligent transportation; energy service providers'—smart grid and metering etc.) and to monitor their progress and performance. *I realized that although Smart City Vienna was at its 3rd year of implementation, it had established a dedicated project consortium and project management team, which could oblige project requirements easily both due to the past agreements and to the controllable city size-of about 2 million residents.*

Definition

Vienna claims that Smart City Wien concerns *the development of a city that assigns priority to, and interlinks, the issues of energy, mobility, buildings and infrastructure* (Vienna City Administration 2014). *During my visit, I experienced several activities that supported this definition, while today several projects appear to support this strategic implementation.*

However, the particularity of the case of Vienna is that the smart city project owner is a group of stakeholders, while no PPPs have been structured and several projects align to a common strategy and purpose: to enhance city's energy efficiency and innovation. The remainder smart city projects that the city develops, come from European funding and support the strategic implementation indirectly. According to the meeting outcomes, Vienna experiences climate change effects in terms of lasting heat waves during summer periods and expects to improve air quality with energy efficiency measures (e.g., renewable energy sources). *I can't tell how today's Seestadt Aspern district-from-scratch will support strategic implementation, but this case aligns to strategic objectives too.*

Sustainability

Vienna is a sustainable city in terms of urban planning and mobility, and a famous historical city that does not expect technology to enhance its reputation. Local economic growth however, has not been prioritized. *I felt that the city government succeeded in making local stakeholders committed to the smart city project with the adoption of common rules and guidelines, and their engagement will make the smart city case to sustain*. Vienna is an eco-city too, and it aims to increase renewable energy use, waste and water management too. *I feel that they can make it happen and my concerns deal with economic sustainability, which is not described in detail in the documents, neither the officials justified it.*

The fringes

Literature evidence show that Vienna self-claims to be smart and my experience shows that rightfully it does, since several smart city projects were being implemented or had already been accomplished, while the city follows sustainable planning. Moreover, the officials followed a careful planning that engaged all stakeholders from the beginning. This project schema is different compared to the remainder analyzed cases, since individual project owners collaborate on a common city's strategy. It looks like the case of Vienna can sustain in environmental and social acceptance terms and it remains to see if it will sustain in economic terms too.

3.4.7 The Case of London

London (United Kingdom) is another international megacity with an increasing population and a big economic center with many companies having their headquarters. The city is also known for its dynamic society, its knowledge capacity with an extensive network of universities and scholars, but with many urban problems ranging from the lack of space, to its heavy traffic conditions that are being supported by a dense network of buses and subway, and demanding waste management requirements.

However, it's not a famous smart city case, neither it appears in smart city reports. Literature lacks in articles about smart city London and only recently have appeared some: Cohen (2012) first ranks London in 5th place internationally with regard to a range of criteria, including innovation, quality of life, level of greenness and digital governance, after Vienna, Toronto, Paris, New York (Hollands 2015). Moreover, Cohen (2012) mentions that London announced a PPP for launching the largest free Wi-Fi network in Europe. Batty (2013) and Mulligan and Olsson (2013) refer to data opening by the transport operators [e.g., Transport for London (TFL)]. Gabrys (2014) discusses about a PPP formulation between ICT companies and the city of London for urban infrastructure retrofitting. Lee et al. (2014) refer to a smart mobile App (BusChecker[107]), which informs people about bus arrival and departure times from specific stations.

The official website for London visitors[108] lists several interesting applications like maps and guides. Similarly, the official website of the local government (City of London Corporation[109]) offers many useful mobile applications[110] for air pollution measurements (the CityAir App), for exploring the city (the City Visitor Trail App and the Enjoy the City App), for locating toilets (City Toilet Finder App), for contacting the police (City of London Police App) and for reporting environmental issues (LoveTheSquareMile App) etc. Moreover, the website provides residents, visitors and businesses with public information and several smart online services, like transportation, online payments for parking tickets and reporting environmental issues etc.

[107]http://www.buschecker.com/app/LON/.

[108]http://www.visitlondon.com/traveller-information/getting-around-london/london-maps-and-guides/apps.

[109]http://www.cityoflondon.gov.uk/Pages/default.aspx.

[110]http://www.cityoflondon.gov.uk/about-the-city/about-us/Pages/social-media.aspx.

In 2013, the city established the Smart London Board[111] from Mayor's top experts—including leading academics, businesses and entrepreneurs—which has identified a corresponding plan (Smart London Board 2014) with initiatives about citizen engagement, further data opening, creativity and innovation enhancement and citizen satisfaction increase. An extensive open data store was launched in 2010 for London,[112] which offers several datasets online and an effective real time dashboard. Moreover, several living labs like the Smart London Innovation Networks (SLINs)[113] have been launched in 2014, with a purpose to support local growth in digital economy. Several smart exemplars are demonstrated regarding smart application development and the IoT. Innovation districts like the East London Tech cluster supports the foundation of these labs (Cosgrave et al. 2013).

I visited London for the purposes of the 3rd annual Ovum Smart to Future Cities[114] *event (April 29–30, 2014) in my attempt to understand smart city London efforts due to the lack in literature evidence, for the purposes of the EADIC project. It was my second trip to London, but my first with a purpose to explore its intelligence, and it took place at a time, when most of the previously mentioned achievements were at their beginning. It was a great opportunity to hear first and to learn by experience about the case directly from government officials (David Willets, the Minister for Universities and Science, Professor Sir Alan Wilson) and from BSI (Dr. Scott Steedman, Director) who were speakers at the event. Accessing downtown from Heathrow on April 28, was an easy process* via *the underground network, which is equipped with intelligent transportation technology and easy ticket issuing. My hotel was at Russell Square, close to the event's venue and I had the opportunity to experience city's performance under extensive traffic, due to the forthcoming 2-day subway employees' strike for the May 1st anniversary.*

I walked until the Piccadilly circus on the first evening (Fig. 3.39) *in my attempt to seek for smart services. I found no public Wi-Fi available, neither location-based Apps on my portable devices (Windows CE and Android-based). I did not see any intelligent signs for public buses and only timetables were available at the bus stations all over. However, the estimated schedules were very accurate in all cases that I checked. I experienced heavy traffic and I was concerned of what may follow the next 2 days. I continued through the Hyde Park, where citizens were enjoying the space until the Knightsbridge and realized how effective the sustainable planning was in the past and thankfully the city kept these open spaces until today.*

I walked to the venue of Ovum's event the next morning of April 29. The streets were completely full of cars due to the subway strike and you needed the same time to access a place either you walked or you took a bus. Even the pedestrian areas were full of people walking to their jobs and thankfully the weather was good this

---

[111] https://www.london.gov.uk/what-we-do/business-and-economy/science-and-technology/smart-london/smart-london-board.

[112] http://data.london.gov.uk/.

[113] http://smarterlondon.co.uk/.

[114] https://smarttofuture.com/.

Fig. 3.39 A representative view of Piccadilly circus

Fig. 3.40 Smart technologies is not only about ICT

morning. My first thoughts were regarding how could smart technologies support cities in "crisis" situations like this and I felt that even if routing applications are available, they are useless in such cases when public transportation is off duty, while only smart communities may contribute in case of encouraging the use of sustainable mobility (e.g., walking, cycling etc.*). Moreover, sustainable city planning is extremely useful for situations like this one.*

Arriving at the event's venue I was surprised of the companies' demonstration booths, where I saw intelligent solutions without the use of ICT. Smart bins were there (Fig. 3.40) *but with no embedded sensors and their intelligence was based on the design, which attracts citizens to score with their gums and cigarettes, while mini pocket bins encourage citizens not to throw their cigarettes on the streets. The vendor*[115] *presented his contracts with the city of London and the city of Edinburgh*

[115] http://www.smartstreets.co.uk/.

as a smart clean streets solution and claimed that in London alone more than 1000 tons of chewing gums and cigarettes are collected from the streets on an annual basis. It was my first experience that when we're talking about smart cities, we mean innovation not-necessary—but mainly based-on the ICT. The remainder demonstrators (e.g., Schneider, Siemens, Hewlett Packard and Microsoft etc.*) were presenting their smart city solutions too.*

I entered the event's room where several presenters were discussing the future of smart cities and they mentioned several smart city cases. Among the most important notes was from Schneider, who claimed that smartness varies from place-to-place: "in Indonesia and Vietnam intelligence is to provide villages with lights that extend their lives during the night; in Beijing is traffic solutions; in Dubai is automated buildings etc.*" a phrase that pointed out that different versions of smart cities exist around the globe. Then, the Future Cities Catapult's speaker noticed that in 2014 the 90% of data ever produced, it was produced during the past 2 years; a presenter of EU-China summit explained the aim of the comparison between 15 cities from EU and 15 cities from China* (CAICT and PDSF 2014). Several smart city cases' presentations followed, explaining similarities and differences mainly from Europe (e.g., Oskarshamn from Sweden; Issy les Moulineaux in Paris; Vienna; Peterborough in U.K.; and Copenhagen).

Similarly, I attended next morning's sessions, where the public officials presented the initiation of the city dashboards with open datasets; defined the role of British standards for delivering smart city programs coming up from different smart city visions; and that in Britain it is London against the remainder cities—mentioning that London's challenges are extremely different to the others—which among others they concern city's resilience against floods, terrorism and cybersecurity.

Scale

There was a mix of experiences that I gained in London: I realized that London was at its beginning in its transformation to an intelligent city and this was the reason that it was not mentioned in literature before. This smart transformation was a complex process that was going mainly to be based on data and standards. London—like every big city—has tremendous problems (like the traffic and even the pedestrian areas' traffic jams that I experienced), where technology alone cannot provide with solutions and only a combination of physical (e.g., transportation networks) and smart systems (e.g., smart applications) can enhance living.

Definition

With regard to definition, *I realized that smart solutions are not necessarily ICT based, but smart design and smart people can enhance urban living like the smart bins that I saw*. The city of London had installed some smart infrastructure (e.g., intelligent transportation at the subway stations and open data was at its beginning), but many things remain to be done to utilize its full potential (e.g., location based services). No Wi-Fi access points were accessible and as a visitor *I could not access most of the online services*. In ecological terms, the city has also a lot of things to do, since the traffic is heavy. Finally, the city of London does not expect technology to enhance its competitiveness against other cities, since its international role has been achieved long before.

Sustainability

Government officials looked determined to proceed to the development of smart London and they mentioned the foundation of a forum (later the Smart London Board) and the utilization of BSI standards for planning and management. *I felt that they can make it happen* and indeed, today, several smart solutions appear to have evolved in London. *However, I didn't see people on the streets enjoying mobile technology, which made me skeptical about how interested local community might be with regard to a smart city.*

The fringes

Literature showed that London did not self-claim to be smart and I realized that rightfully it cannot be labeled as a smart city case, since at that day the officials were completing their preparations to initiate a corresponding program. It is proved to be the right way: think first; plan and engage; standardize and implement. Of course, London does not fear the international city competition, it performs well in this arena and in this regard, it has plenty of time to plan. However, as a megacity, it needs smart solutions in order to enhance its living conditions, in terms of sustainability and resilience, mobility and citizen satisfaction.

3.4.8 The Case of Washington DC

Washington DC does not concern a well-known smart city case and it is rarely mentioned in literature for its intelligence. However, the role of Washington as a global city and the capital of the U.S.A. is known: Brown (2014) signalizes that Washington DC becomes—together with New York and Chicago—more important geopolitically than the United States as a country, he ranked the city first with regard to mobility connections and discusses potential smart planning with a view on 2050. Moreover, Washington DC appears in literature several times mostly about its potential and sustainability and less with regard to its intelligence: Zhang and Zhao (2009) claim that the city has a branding of "power"; Herrschel (2013) discusses Washington State's government planning with "Smartness" in 1992, in its attempt to enhance regional development through collaborative engagement in order to address rapid sprawl, road congestion and the insufficient provision of public transport outside the central-city area; Amiri and Sadeghpour (2014) investigate city's sustainable mobility's low potential with regard to cycling, due to safety reasons; Cavallo et al. (2014) demonstrate that Washington DC produces the most 311 service-data in the country when citizens interact with local government for information requests or complaints; Desouza and Flanery (2013) question city's energy efficiency and sustainability; while Davies and Msengana-Ndlela (2014)

Fig. 3.41 Representative view of streets, sidewalks and cycling lanes in Washington

show how the city's government adopted LED technology to minimize energy expenses. Moreover, the official website of the local government[116] provides residents, visitors and government with plenty of information and online services, like the 311 service; open data[117]; and complaints' submission.

All the above information and 3 more reasons oblige me to present this case. *I visited Washington in order to attend the Kick-off meeting of Global Cities Challenge and to interview the Director of Middleware Engineering and Rapid App Development of the World Bank. Attending the workshop was an opportunity to understand how smart cities are being evolved in the U.S.A., while the experiences from the World Bank would help me realize how smart cities are being evolved in the developing countries. This trip helped me to experience and share with you, smart city initiatives that are being developed in the city of Washington DC too.*

I arrived in Washington on September 28, 2014 at the Dulles airport, which is about 40 km from the city. I used the subway connection that took me approximately 1-hour trip to get downtown and access my hotel. The next morning, I started my walk from my hotel to the World Bank headquarters, located at 1850 I (Eye) Street (Fig. 3.42). *I enjoyed too much the open spaces of the city* (Fig. 3.41) *and the large streets of 4–6 lanes, without a heavy traffic and not that tall buildings, which reminded me a lot the European capitals. My meeting with the World Bank's director (I leave his identity out for privacy concerns) started at 11 am, lasted an hour and several important outcomes about World Bank's role in smart city domain were explained*. The director confirmed that according to the World Bank,[118] Cities are becoming the new ecosystems for innovation, since the ICT offer great potentials (e.g., cloud computing, open software, open data etc.). The World Bank partners—mostly—with governments in developing countries with

[116]http://dc.gov/.

[117]http://opendata.dc.gov/.

[118]http://blogs.worldbank.org/category/tags/smart-cities.

Fig. 3.42 The meeting venue

regard to smart city projects (e.g., innovative technology and mobility solutions in the Smart City Gran Concepción in Chile). Additionally, World Bank undertakes various initiatives and workshops as a means to engage solution providers, thought leaders and development partners in smart city definition. In Smart Cities for All workshop, it seems that the World Bank sees smart city as an innovation arena under the following lens:

(1) Smart Climate as a means to deal with environmental degradation.
(2) Smart Planning as a means for Poverty avoidance.
(3) Smart Mobility.
(4) Smart Economy.

The above findings show that the World Bank emphasizes on 4 of the smart city dimensions: economy, mobility, environment and living.

In the end of the meeting I went directly to NIST campus, located outside the city at the Gaithersburg district. I used the subway that took me approximately 1 h to access the venue (Fig. 3.43). *Intelligent transportation was installed in the subway informing about the trains' arrival and departure times, while no Wi-Fi or location-based Apps were available across the city or during the entire trip to the venue. Only an efficient bike-sharing system was located downtown. The workshop was exciting and representatives from most of the U.S. cities presented their ongoing smart city initiatives*. A very interesting smart city case in Washington was introduced by CISCO representatives. It concerned the PA2040[119] project, the aim of which is to utilize sensors and smart technologies to enhance visitors' experience, with DC-net Wi-Fi and remotely managed, sensor-based LED streetlights across the Pennsylvania Avenue. Moreover, the proposed smart lighting system was supposed to offer different coloring according to particular events (e.g., empty parking space, crime event etc.).

[119] http://octo.dc.gov/page/pa2040-project.

Fig. 3.43 The kick-off of NIST global city teams challenge (http://www.nist.gov/cps/global-city-teams-challenge-workshop.cfm)

Scale

After all this experience, *I realized that a smart city can exist without "shouting it"*. Washington DC offers several smart services without being a known case, it undertakes several pioneering projects without making noise about their potential, while it does not wait for technology to support its sustainable planning: it consists of open spaces, cycling and pedestrian lanes, while it has adopted several types of smart technologies (e.g., e-government services, open data, intelligent transportation etc.). However, Washington DC faces alternative challenges like safety and energy efficiency, over which smart technologies can provide with solutions.

Definition

With regard to definition, Washington DC can be considered a smart city, although it does not utilize its full potential (e.g., location based services for the museum collection). No Wi-Fi access points were accessible and as a visitor I could not access most of the online services. In ecological terms, the city performs well and technology can support its performance further.

Sustainability

Interventions already exist and past literature evidence shows that the local government proceeds carefully. In this respect, the existing solutions are estimated to sustain. *I didn't see people on the streets enjoying mobile technology though, which made me skeptical*. Finally, the city has followed sustainable planning in terms of mobility and it can improve it further with the utilization of smart technology.

The fringes

I realized the role that marketing plays in the smart city nexus: Washington DC performs great as a smart city and offers several smart services without being a famous case or self-claiming to be a smart city. *I wasn't surprised since it's one of the most important U.S. cities and I expect to see further outcomes about this case in the future. Moreover, I gained the experience of smart city deployment in* *developing countries, from my discussion with the World Bank's director*: The World Bank sees smart city success in economic terms only and in this regard, it's willing to support governments in meeting mutual interests.

3.4.9 The Case of New York City (NYC)

New York City (NYC) is famous, which like Washington DC is estimated to be smart, without being a famous smart city. Literature evidence is quite scarce with regard to smart NYC: Cavallo et al. (2014) investigated 311 service-data production when citizens interact with local government for information requests or complaints and rate NYC second after the Washington DC. The planning document entitled New York City by 2030 or PlaNYC 2030[120] (NYC 2007) emphasized on sustainability and smarter land use, implemented by corresponding interventions like brownfield redevelopment (Pearsall 2013). PlaNYC was updated in 2011 (NYC 2011) in cooperation with the Department of Information Technology (DoITT), with the incorporation of the "Road Map for the Digital City", a plan to increase citizens' engagement through digital channels and improve the way the city provides data and electronic transactions. As part of this plan, NYC launched its open data[121] and open APIs[122] initiatives on October 2011 in its attempt to enhance local creative economy.

The 2011 NYC plan was updated in 2015 to the "One New York: The Plan for a Strong and Just City" for sustainability and resilience, which specialized smart city on "Building a Smart + Equitable City" (NYC 2015) and prioritized smart buildings; smart mobility; smart environment (waste and water); smart health and safety (air quality and crime monitoring); and smart government. Among several innovative undertaken initiatives,[123] the deployment of a municipal Wi-Fi network entitled LinkNYC[124] was launched in 2015, which consists of more than 7500 links (each providing free-of-charge gigabit Wi-Fi, phone calls to anywhere in the U.S., device charging, a touch screen tablet for Internet browsing, access to city services, maps and directions, and a 911 Emergency Call button) across the city. Local government's official website[125] serves more than 35 million unique users per year, it offers sets of smart services like access to 311 services (e.g., complaint registration and online payment etc.) and a corresponding mobile App; access to city facilities' information; connection with social media feeds; job search etc. NYC's 311 center

[120] http://www.nyc.gov/html/planyc/html/home/home.shtml.

[121] https://nycopendata.socrata.com/.

[122] https://developer.cityofnewyork.us/.

[123] https://www1.nyc.gov/site/forward/innovations/projects.page.

[124] https://link.nyc/.

[125] http://www1.nyc.gov/.

alone is supported by more than 400 civil servants, it answers more than 50,000 calls per day and provides more than 4000 services in more than 180 languages.

I visited NYC right after my trip in Washington on October 1st 2014 for the purposes of a meeting that I had arranged with DoITT, in my attempt to discuss and understand its smart city context, under the purposes of the EADIC project. Arranging this meeting was a hard process that took me more than 3 months of electronic message exchanges and phone calls. However, this was a normal process, since such a meeting's arrangement requires Mayor office's authorization first, while several security concerns had to be resolved, especially for a meeting with a foreigner.

I arrived at JFK international airport and accessing the city was a simple 30-minute subway connection. My hotel was located in Manhattan close to Times Square (Fig. 3.44). *Since it was my first visit to NYC I was surprised of the buildings' density and city's size, traffic and noise. I did several walks in the area and I tried to access public Wi-Fi and location-based Apps with my portable devices but with no luck. I experienced intelligent transportation services only at the subway, where the ticketing system was simple and charges you according to your destination. Walking around the streets gave me the sense of the crucial role of planning and smart technology's deployment against climate change and sustainability concerns, which are very hard to be resolved for such a big city.*

Fig. 3.44 A representative view of Times Square

Fig. 3.45 The meeting venue

My meeting had been setup by the DoITT's Director of External Affairs for October 3rd at noon, at 2 MetroTech Center, a DoITT building in Brooklyn (Fig. 3.45). *My interviewed experts were the DoITT's Deputy Commissioner and the DoITT's Associate Commissioner, followed by their team of 3 colleagues (I leave out their identities for privacy concerns). Our meeting lasted an hour and they were all willing to present me their smart city case in detail.*

Scale

After all this experience, *I realized that a smart city is really useful for a megacity, where resource management, lack of space and growing population are the primary features*. On the contrary, *the NYC does not expect from technology to enhance its competitive role in the international economic arena, since it's had been world's economic center for decades. However, local growth is a top priority in local government's agenda and open data policies were on the go*.

Definition

With regard to definition, a visitor cannot realize that NYC is smart, since most smart services were not available during my visit and most appear to have been launched later. No Wi-Fi access points were accessible and as a visitor *I could not access most of the online services*. However, *after my discussion with DoITT I can ensure you that NYC highly concerns a smart city case: it is* ***based on more than 60 data centers*** *that serves more than 300,000 civil employees, located across the city; the overall architecture is multi-tier that was being evolved to a cloud-based one; while the overall smart city planning respects security issues and protection against cyber-threats significantly, after the 9/11 terrorist attacks. Moreover, the release of more than 1200 open datasets from more than 80 entities had generated more than 3000 new companies in the data economy within 2 years*. In ecological terms, the city aimed to deploy thousands of sensors to support environmental conditions' monitoring, while several urban planning interventions were being scheduled by the local government.

Sustainability

All smart city interventions are being funded by the State budget. However, *according to the interview's outcomes their viability is not considered under the strategic planning, but the State aimed to move towards that direction. The overall smart city strategy was being implemented in phases, while its initial one aimed to reduce administrative expenses (e.g., with voice-over-IP telephony connection between State agencies). However, open data had already generated a dynamic local data economy, which consisted of more than 3000 new companies at the time of the meeting*. Establishing a sustainable city planning was not part of DoITT's strategy, *but the Department aimed to work on sensor deployment that deal with air and water quality monitoring and traffic control*.

The fringes

I realized that smart city is not a theory. The world cities like the NYC face the challenges of climate change, safety and resource control and in terms of scale, NYC is one of a kind, although a visitor probably will not experience it. Probably, this may have changed after the launch of linkNYC. *The community in NYC does not behave like in Asian exemplars that I had experienced and the local government has to be dedicated in establishing the smart city mission.*

3.4.10 The Case of Hong Kong

Hong Kong is another important Asian case, which started working on a smart city strategy in 1998, entitled Digital 21 Strategy[126] (Commerce and Economic Development Bureau 2013; OGC 2013), drafted and managed by the Office of the Government Chief Information Officer (OGC) of the Government of the Hong Kong (GovHK)[127] Special Administrative Region (HKSAR), as the blueprint for Hong Kong's overall development in Information and Communications Technology (ICT). This strategy has been updated four times in 2001, 2004, 2008 and 2014 and utilized the local ICT infrastructure, business and innovation potential. The implementation of such a policy appears to be feasible for such an Asian case with the following characteristics: centralized governance favoring shorter decision-making processes for public investments and more rapid development times for their execution; high economic development rate; low political risks; and unique weather conditions that determine particular needs (Neirotti et al. 2014).

According to the latest update of this strategy, Hong Kong performs well in most smart city models' indicators (CPU 2015); it performs great in smart economy and electronic transactions; it has been awarded as the safest Asian place in 2011; it develops a district from scratch (Cyberport) with smart infrastructure (Angelidou

[126]http://www.digital21.gov.hk/eng/index.htm.

[127]http://www.gov.hk/.

2014); it has undertaken several sustainability initiatives (Vojnovic 2014) like walkable districts and green policy planning; while it has undertaken initiatives for all smart city dimensions; while it offers several smart services (e.g., government Apps like the MyGovHK,[128] government services, hotline 1823 etc.) (CPU 2015). With regard to further smart city development, GovHK has planned the development of 20,000 Wi-Fi public access points and the utilization of the IoT for real time traffic and city management.

Similarly, several city websites provide residents, visitors and businesses with useful smart services like, real time traffic information[129] and route identification[130]; online government services[131]; several health and welfare services (e.g., shelter provision with citizens of low income); business forum[132] and motives for foreign investments[133] and investments in innovation and data economy[134]; green interventions like the Environmental Impact Assessment (EAI) process[135] and waste management[136] etc.

I arrived in Hong Kong on December 2, 2014 in the evening. Accessing the city was extremely simple by train and the overall entering process was very fast, which can be justified by Hong Kong's free economic zone. All the above information had increased my expectations regarding smart city's performance. When I arrived at my Hotel in Tsim Sha Tsui southern district, I tried to access public Wi-Fi and location based Apps from my portable devices (Windows CE and Android) but I could not locate any, although I walked all over the district. The weather was warm for December and I moved to the closest subway station (East Tsim Sha Tsui) to access the Central District. I saw free internet service booths at the subway station (Fig. 3.46) *operating by the subway provider, although I could not locate any free Wi-Fi network at the station. The ticket issuing process was extremely simple and fast for a visitor and charging varied according to the destination. I went to the Central District that is located on the Hong Kong island and I tried to locate public Wi-Fi and location-based Apps on the streets, but again there was nothing available on my devices. However, I saw an environmental station, equipped with sensors that collect information about local air quality conditions* (Fig. 3.47).

I had arranged an hour meeting with OGC Senior Administrative Officer and her colleagues (I leave out their identities for privacy purposes) on December 4,

[128]http://www.personalised.gov.hk.

[129]http://traffic.td.gov.hk/selection_e.htm.

[130]http://hkerouting.gov.hk.

[131]http://www.gov.hk/en/residents/onlineservices/.

[132]http://www.gov.hk/en/theme/bf/communication/blg/index.htm.

[133]http://www.gov.hk/en/business/supportenterprises/localenterprises/#/en/business/supportenterprises/foreignenterprises/.

[134]http://www.gov.hk/en/business/supportenterprises/localenterprises/#/en/business/supportenterprises/innovation/.

[135]http://www.gov.hk/en/residents/environment/air/#/en/residents/environment/eap/.

[136]http://www.gov.hk/en/residents/environment/waste/msw.htm.

Fig. 3.46 Free Wi-Fi access booths

Fig. 3.47 Air quality measurement station

2014 in the evening. Arranging a meeting with the government agents was a hard process, which was initiated almost a year before and confirmed me how different the Asian political system is. *The meeting venue was at the East Wing, Central Government Offices at Tamar, in a Government building, located at the Central District. I used the subway again and I accessed the Admiralty station, which was just across the venue. Several Government buildings are located in the area, while I saw posters on the streets demonstrating the availability of government Apps* (Fig. 3.48) *that I had never seen before. I used a printed map to find my way to the venue* (Fig. 3.49) *since as a visitor I had no Internet connectivity on the streets. My walk at the overall district showed me both open spaces* (Fig. 3.51) *and typical, dense and dirty roads* (Fig. 3.50)*—that I expected to see due to Hong Kong's space limitations—which showed me how the old buildings are equipped with traditional air-conditioning systems. I arrived earlier and I was waiting on a coffee shop*

Fig. 3.48 Posters informing about government apps on the streets

Fig. 3.49 The meeting venue

located at the venue's lobby. My portable devices located a public Wi-Fi named WiFi@HK, but its performance was extremely poor and I could not access it.

Our meeting started on time and the Senior Administrative Officer (Strategy Development) accompanied by 2 executives honored me with an hour discussion. Several useful outcomes came up from our discussion, which validated Digital 21 strategic thrusts and corresponding performance monitoring; the overall strategic implementation—so as the Wi-Fi hotspots—was based on PPP; IoT, big data and smart infrastructure was being encouraged by OGC and lots of sensors were being installed in public buildings and spaces to measure temperature, air quality and traffic; several e-government services were being deployed too via the personalized GovHK-MyGovHK platform; while an open data initiative had been launched[137] with several open datasets from government agencies.

[137] https://data.gov.hk/en/.

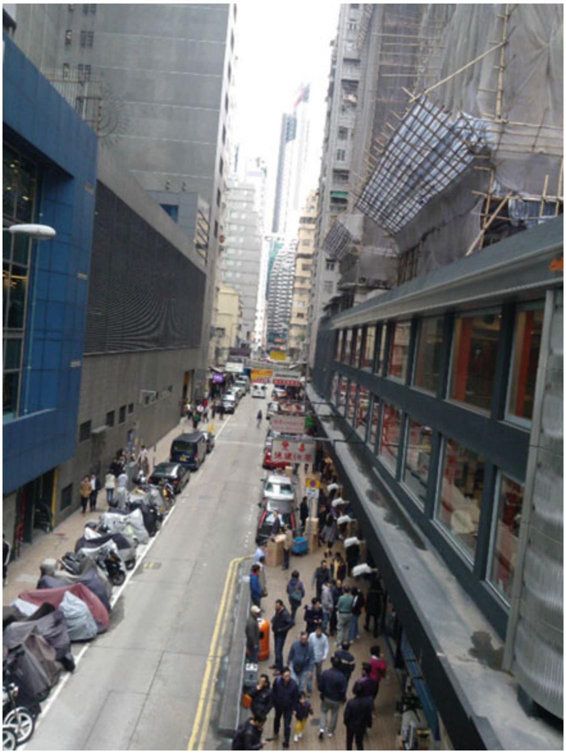


Fig. 3.50 A representative view of Hong Kong old and dense spaces

Scale

After all this experience, when considering scale, *I realized the importance of smart city for places with size and economic power like Hong Kong, which face climate change effects and demand smart interventions: a dense city space limitations for further sprawl and huge population, part of China with a free economic zone, a typical Asian Government and a strong ICT economy. It gave me the sense of a smart country and not a smart city, where a dedicated Government can easily initiate PPPs and develop its strategic thrusts*. On the other hand, urban planning (like open space development) is not simple for Hong Kong due to the lack of space.

Definition

With regard to definition, Hong Kong has established most of its smart city promises. Although Wi-Fi access points were under development and as a visitor *I could not access most of the online services and Apps, these services exist and IoT is being deployed*. In ecological terms, a few open spaces, many old buildings and huge traffic size require many interventions for waste, traffic and emission control.

Fig. 3.51 A representative view of Hong Kong open spaces

Sustainability

I saw mostly young people on the streets enjoying mobile technology, which shows that smart technologies together with the efficient local ICT industry is more likely to sustain in Hong Kong. However, the city limitations and existing facility does not leave enough room for mobility interventions (e.g., cycling lanes etc.), while building renovation demands many resources.

The fringes

During my visit, I realized the meaning of ageing society in western economies: the average age of people walking on the streets was between 25 and 35 years, while in western societies normally ranges between 40 and 50. Residents have adopted smart mobile technology and they use it frequently. Despite its economic strength, poverty can be seen in Hong Kong too, which may generate a technological divide due to parts of community's inability to access technology and corresponding opportunities (e.g., data economy). Hong Kong is really a successful smart city story but like Seoul, *I did not feel that technology alone can support the city in the international arena, where Hong Kong has a really outstanding performance as a free economic zone and a well-organized administration.* These features, together with its ICT industry and young society, are its most competitive advantages that are expected to support the city to sustain against South Korea, Japan and Singapore etc.

3.4.11 The Case of Melbourne City Council

Melbourne has been ranked several times as the most livable city in the world. Livability stands for local quality of life and citizen satisfaction in terms of education, environment, stability, healthcare, and infrastructure (Akçura and Avci 2014; Holden and Scerri 2013). Livable Melbourne is the outcome of a development, policy and planning path, while today is the showpiece, the workplace, and the venue for the young and restless to play (Holden and Scerri 2013). Ranking shows that Melbourne city offers a low level of socioeconomic disparity, while it demonstrates equity and social welfare, post-industrial economic development, tourism, and a particular kind of lifestyle.

However, this livable performance questions the role of intelligence in city planning and operations. The importance of this question increases, especially after articles arguing about smart city development in Australia[138] and reports focusing on Melbourne's energy efficiency (Commonwealth of Australia 2009; AEFI 2014), which interrelate smart city and smart grids' deployment. Only recently, Melbourne appeared to discuss smart city and joined the IBM Smarter Cities Challenge in 2016.[139] Moreover, a corresponding open data policy was adopted on November 2014,[140] which focused on the development of an accessible, transparent and responsive organization and that resulted to the city's open data portal.[141] City's official website[142] offers online services and information for residents, visitors and businesses (e.g., reporting street repairs, graffiti and noise issues; pay parking fines etc.), while it demonstrates city's plan for a knowledge city.[143] With regard to ecological issues, the city provides useful information about urban planning for sustainable living; energy savings; and green economy. All the above information generates high expectations to a visitor with regard to what can someone experience in Melbourne and whether this experience concerns only satisfaction from quality of life or it deals with smart technologies. *I visited Melbourne right after my trip in Hong Kong on December 7, 2014. It was a direct flight for the purposes of EADIC project, since I had arranged a meeting with Melbourne city's officials that supervised smart initiatives at that time.*

After arriving at the airport, I was quite surprised from the lack in train connection to a highly livable city, which is 20 km away and only a bus option of more

---

[138] http://www.smh.com.au/it-pro/government-it/australian-cities-in-no-hurry-to-become-smart-20141027-11cbnt.html.

[139] http://www.melbourne.vic.gov.au/about-melbourne/melbourne-profile/smart-city/Pages/smart-city.aspx.

[140] http://www.melbourne.vic.gov.au/about-council/governance-transparency/Pages/Open-data.aspx.

[141] https://data.melbourne.vic.gov.au.

[142] http://www.melbourne.vic.gov.au/.

[143] http://www.melbourne.vic.gov.au/about-council/vision-goals/knowledge-city/Pages/a-knowledge-city.aspx.

Fig. 3.52 Melbourne representative open spaces

Fig. 3.53 The entrance of the meeting venue

than 1-hour trip is available. I stayed at a hotel located downtown, at a walking distance from the Melbourne City Council, where the meeting venue was located. I began my walking trip to the venue (Fig. 3.53) *on the afternoon of December 9, 2014. It was the beginning of summer in Melbourne and people enjoyed the sun on a plenty of parks located downtown* (Fig. 3.52)*, close to the local RMIT university and to the river, while various monuments and creatively designed buildings are over the place* (Fig. 3.54). *I experienced an efficient local public transportation network, consisting of trams and buses, having installed some smart signs at their stops. I was quite surprised by young people that did not hold portable devices on the streets and at the parks, while my attempts to locate public Wi-Fi networks or location-based Apps failed.*

Fig. 3.54 Melbourne a style of creative building design

Scale

My appointment with the officials (I leave their identities out for privacy concerns) lasted for more than 1 h, who appeared extremely wiling to demonstrate their smart city efforts. They explained me the government structure: (a) the Federal Government, operates above all the 6 Australian states[144]; (b) the State Government governs one of the 6 Australian states; and (c) the Local Government (City Councils) serves a particular urban community. The city of Melbourne consists of 28 different municipal councils,[145] one of which is the Melbourne City Council that represents 100,000 habitants and works on behalf of all of them in international meetings. The Strategic Planning Office defines Melbourne City Council's individual planning, while it adopts Victoria State's planning. At that moment, the Melbourne City Council plan 2013–2017 was under the implementation process.

Definition

Several interesting outcomes came up from our discussion: according to the Strategic Planning Office's presentation, Melbourne City does not adopt a clearly defined smart city term, while they agreed with the definition about "*Innovations in the urban space that enhance wellbeing in terms of people, governance, economy, environment, mobility and living*". To this end, they do not adopt smart industry's efforts and Melbourne aims to define solutions that address local community's needs.

Sustainability

The initial thinking about smart city had started 4 years before the meeting, back in 2010, when the City of Melbourne hosted a C40 Cities workshop[146] in its attempt

[144] http://www.australia.com/about/key-facts/cities-states-territories.aspx.

[145] http://vro.depi.vic.gov.au/dpi/vro/map_documents.nsf/pages/vic_lga_melb.

[146] http://www.c40.org/.

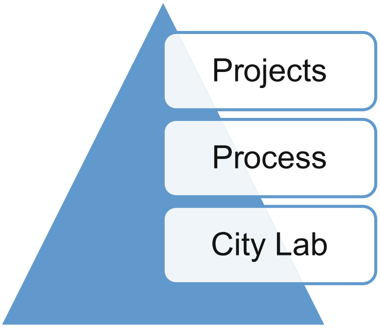


Fig. 3.55 The design thinking process of Melbourne city lab

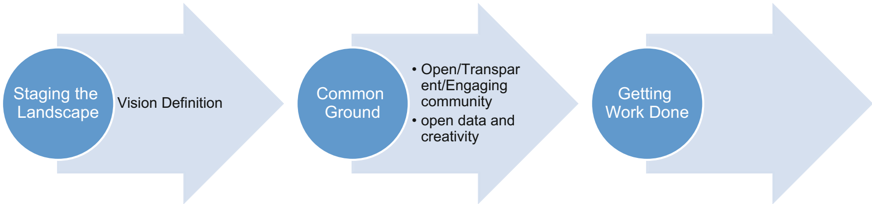


Fig. 3.56 Collaboration phases

to explore the positive impact that urban informatics and 'smart systems' have on the sustainability ambitions of the city.[147] The workshop was facilitated by Arup and the resulting Melbourne Smart City report included a number of examples of how such technologies and ideas might be deployed across the city. During this event the community and various stakeholders were asked to define their needs.

The overall problem definition was a design thinking innovation process, which was supervised by the Strategic Planning Office, while a Living Lab (City Lab) was structured for the purposes of the digital strategic definition for the Melbourne City Council. The City Lab defined the appropriate collaboration process, which plans the projects that can enhance smart living in Melbourne (Fig. 3.55). Municipality of Melbourne City was supported in this process by Arup as well as by CollabForge,[148] which was one of the first creative companies in Melbourne.

The above collaboration process was performed in the following phases (Fig. 3.56).

A number of requirements had been identified so far, during a number of repetitive community meetings. These requirements had been incorporated in the

---

[147]http://www.cityofsound.com/files/c40_melbourne_report_final_email.pdf.

[148]http://collabforge.com/.

Council planning agenda for 2017 (City of Melbourne 2013), which can be summarized in the following:

– The development of an open and transparent government, which can engage community.
– The deployment of Municipal open data as part of the State open data initiative,[149] which can support the definition of a broader city vision.
– The development of local creative industry, with the kick-start support of new born companies by the Municipality.

Furthermore, the above strategic planning's priorities can be summarized in the following:

1. City can build solutions on its own strengths.
2. City creates a "soft power" of smart city capabilities.
3. City defines its smart vision: Remain Livable in terms of Live/Work/Play.

Council's strategy was in place, with a shared community vision; offering open data to the community with a consolidated data strategy; following a government model, which is linked with neighboring councils within Melbourne; and it will deal with Municipal facilities 18 months after strategic implementation start. According to these findings, indeed the Melbourne City Council did not supervise a common smart city program at that time, and all existing smart solutions in the city were being offered by various stakeholders. The following smart city services were identified in the city:

1. Intelligent transportation system, which was offered by the local transportation service.
2. Smart parking solutions, in specific city areas, which were offered by parking vendors and by shopping centers. Some of them were state of the art, such as smart lighting (changing colors for parking open spaces).
3. Smart Safety services with cameras for traffic control and corresponding violation, which was offered by the State Government.
4. A free-of-charge metro-WiFi network was planned to be implemented in the city, in 16–18 months, under the State broadband strategy.
5. Various e-services were being offered by the Municipal website[150]

However, the City aimed to engage all stakeholders to work together in smart city initiatives, which enhances smart city's sustainability.

The fringes

All the above information provided with answers the following questions:Is Melbourne impacted from the government planning and corresponding digital

[149]https://www.data.vic.gov.au/.

[150]http://www.melbourne.vic.gov.au/Pages/default.aspx.

strategies? *Yes, it is, both by Federal and State Governments, while the city defines its own strategy.*

Does the Melbourne's smart city's vision—if any—agree on all the following Smart City components?

1. Smart People: *yes, it engages people in strategic planning*.
2. Smart Economy: *yes, it enhances local creative economy*.
3. Smart Mobility: *yes, with intelligent transportation and various networks*.
4. Smart Living: *yes, with federal safety services and with the livable vision*.
5. Smart Environment: *yes, with the rest livable strategic vision*.
6. Smart Governance: *yes, with the clear open data initiatives*.

3.4.12 The Case of Dubai

Dubai is a modern city and the capital of the Emirate of Dubai, one of the seven emirates that structure the United Arab Emirates (UAE). The city has been grounded on a land, covered with sand for approximately 5000 years, mostly after 1996 and 2008 (Lee and Oh 2008) and today is populous and attractive place, offering facilities and market attractions, as well job opportunities. First evidence for smart city in Dubai appear in 2004, when a smart city cluster appeared entitled "Smart City[151]", consisting of the city of Dubai, Malta and the city of Kochi (India). This effort was supervised by a corresponding company (Dubai Holding) with mainly real estate activities, which developed the Dubai Internet and the Dubai Media cities in an attempt to offer cutting-edge facilities that could attract company relocation in the area. Some literature evidence for the case of Dubai come quite late: National Information Society Agency (NIA) (2007) names Dubai as the IT hub in the Middle East and the establishment of the basis for multi-national IT enterprise; Al-Hader et al. (2009a, b) present the development plan and the architecture of smart city, based on the Internet and Media city paradigms. Evidence disappear since then, and only recently it is being discussed again: Lerner (2013) claims that Dubai's technology advancement, security infrastructure, and innovative planning and action are utilized to lead on the global development of "emerging hubs" for transport and services; Mohammed et al. (2014) discuss of the Dubai's potential for the deployment of futuristic smart transportation services, based on Unmanned Aerial Vehicles (UAVs); Kourtit et al. (2014) and Perera et al. (2014) locate smart Dubai among the leaders in smart city development, which is based on a brand-new strategy; Efthymiopoulos (2016) explores cyber-security issues and names smart Dubai *a leading partner in not only technological innovation but also designed infrastructure and strategic security* that becomes a large and global market competitor.

[151]http://www.smartcity.ae/.

The project ownership is quite confusing: the primary references for the smart city of Dubai was held by a private company (Dubai Holding); Dubai eGovernment was launched in 2000 to pioneer smart city solutions; while Dubai's Executive Office appears to be founded later in 2001 in State Government (Efthymiopoulos 2016), to lead smart strategic growth. Moreover, if someone crawls smart Dubai, another organization appears to adopt State's vision and to lead smart initiatives, which is named Smart Dubai Government Establishment (also known as Smart Dubai Gov or SDG).[152] Nevertheless, another brand name appears in the results of such a crawl, labeled Dubai Wholesale City[153] and it concerns a wholesale trading hub, operating under TECOM Group, which is one of Dubai Holding group's members.

The official website of Dubai[154] offers information and several services to citizens, residents, businesses, visitors and government entities. It is the first case, which differentiates citizens from residents, something normal due to the limited permit that can someone get in order to stay and work in Dubai.

With regard to the adopted smart strategy, primary evidence discusses a development plan drafted in 2000 that could promote smart city to residents and tourists; of a wider UAE's effort to meet the commitments to the United Nations sustainable development and activities to meet the high standards of living but also affordable and sustainable living for the twenty-first century (Efthymiopoulos 2016). Official reports (Smart Dubai 2015a, b) demonstrate the smart development timeline and define a strategic goal for Dubai to become the world's smartest city by 2017, with several activities aligned to Giffinger et al. (2007) smart city dimensions. This strategic document defines the "Future Dubai" vision too, which will utilize data integration, ICT infrastructure and alternative channels (with the appropriate legal framework's adjustment) in an attempt to optimize Dubai's performance with regard to UN's key-performance indicators and to deploy several smart services by 2017. Moreover, the State government has developed another strategic plan for 2021,[155,156] (Efthymiopoulos 2016) (Fig. 3.57), which includes activities in the sectors of the economy, the society, the people, the experience, the government, and the place, with the implementation of several interrelated activities. This last plan prioritizes happiness; cohesion; livability; and smartness.

All the above information questions the ambiguity with regard to who really develops the smart city of Dubai and how the involved organizations collaborate. Moreover, high expectations to a visitor of a futuristic and probably the "smartest city" in the world are being produced from the above evidence.

I had arranged a meeting with the Official Public Relations representative from the Smart Dubai Office (I leave out his identity for privacy concerns), after a

[152]http://www.smartdubai.ae/.

[153]http://www.dubaiwholesalecity.ae/.

[154]http://www.dubai.ae.

[155]http://mediaoffice.ae/en/dubai-strategic-plan.aspx.

[156]http://www.dubaiplan2021.ae/.

Fig. 3.57 The structure of the strategy for Dubai 2021 (from Dubai Media Office)

Fig. 3.58 A representative view of the Dubai Marina district

request to discuss about the case via *the Smart Dubai website and corresponding messages' exchange*. The meeting was arranged for November 17 in the afternoon, at the at the Smart Dubai Office, 34th Floor, Emirates Towers Office Building, located at the Dubai International Financial Centre (DIFC) district (Figs. 3.60 and 3.61).

I arrived early in the morning of the same day in Dubai. The primary transportation means in Dubai is the taxi and I took one to deliver me from the airport to

Fig. 3.59 A representative view of the buildings

the Dubai Marina district—where my hotel was—and from there to the meeting venue, later the same day. The weather was soft and I was impressed of the outstanding buildings and facilities across the 6–8 lane avenues, a futuristic metro network, which validated my initially grounded expectations (Figs. 3.58 and 3.59). *I tried to locate a metro Wi-Fi or location-based mobile Apps on my devices (iOS) but with no luck. I walked in the government building to access the meeting venue and I experienced several state-of the art ICT-based solutions around, like curved-screens and future banking with robot interfaces* (Fig. 3.62).

The meeting lasted approximately an hour and several useful outcomes were extracted, which clarify the case of Dubai. More specifically, *according to my interviewee*, Smart Dubai concerns a Directorate General, founded by his Highness Sheikh Mohammed Bin Rashid Maktoum, Ruler of Dubai, in his vision to modernize and digitize government public services and to simplify citizens' transaction with government services. During this meeting, *my interviewee presented* the Smart Dubai case in brief, which can be summarized in the following remarks:

Fig. 3.60 A representative view of the DIFC

Fig. 3.61 The meeting venue

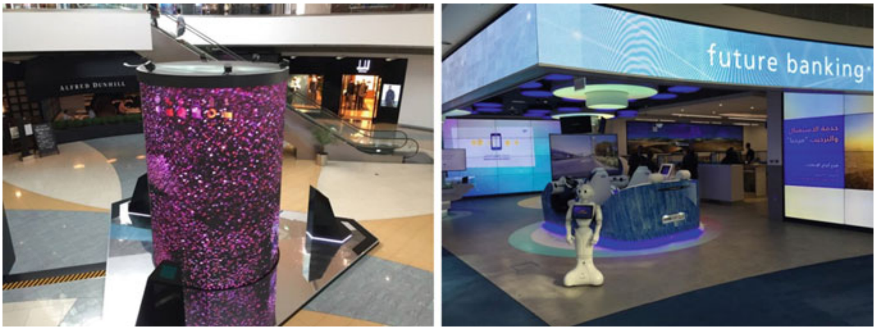


Fig. 3.62 Cutting-edge solutions located at the venue building

(1) Smart Dubai initiative was launched on March 2014, following-up an e-government initiative that was initiated in 1999. Smart Dubai envisioned to transform Dubai to a sustainable city and to enhance people's happiness, within a highly competitive international arena. This initiative is different to the past private efforts to the smart city, as well as to the wholesale city ones.
(2) Smart Dubai's objective concerned the integration of approximately 100 public services, via 1000 initiatives, which addresses the development of a Smart Dubai Government, according to the scientific terminology.
(3) In general, Dubai government has followed a shared-infrastructure approach, which has resulted to a number of savings of AED 4.3 billion (~€1.1 billion) during the last 17 years, while the e-government agenda alone saves 5.6 AED per 1 AED that is being spent.
(4) Today, Smart Dubai is supported by a private company (named Xische[157]) has focused on the following 4 major initiatives:

   a. **Happiness Agenda**: Approximately 500 happiness points have been installed in Dubai, which measure a happiness index real time, according to citizens' satisfaction from public service execution. Today, happiness index has been calculated to be 89%, with an objective to reach 95% by 2021.
   b. **Open Data**: Dubai government launched its data initiative with the definition of 21 open data policies and with the engagement of 150 data champions. Dubai government has partnered with DU in this challenge, while it utilizes in this regard the end-to-end Smart Dubai Platform and Dubai now smart app.
   c. **Blockchain Strategy**: Blockchain[158] is a cutting-edge technology that represents a document repository that ensures their accuracy and certification. Dubai government aims to transfer all public services on Blockchain by 2021.

[157] http://xische.com/.

[158] https://www.blockchain.com/.

d. **2021 roadmap**: Government is committed to the above initiatives and monitors their implementation with effective methods. Dubai government aims to integrate all city services under the above technologies (from applying for a Visa to booking a taxi transfer).

(5) Dubai government has founded Dubai Future Foundation,[159] which is a public organization-business accelerator that defines mid-term challenges (5–10 years) and undertakes corresponding implementations.
(6) Smart Dubai exemplars:

a. **Happiness meter**: a prototype was launched in 2014 and measures citizen satisfaction from public services.
b. **Dubai now**: a smart application (app) that provides a citizen with access to more than 50 public services that are being offered by 22 public agencies.
c. **Saad**: an artificial intelligent (AI) application with machine learning techniques that supports citizens during public transactions.
d. **Smart Dubai platform**: an end-to-end city management application.

Scale

In terms of scale, Dubai is an enormous case and one of a kind. It concerns a new city, built with state-of-the-art design and technology, and offers many futuristic solutions (like future banking, Dubai-Metro,[160] buildings etc.). After his experience, *I realized the role of funding availability and indeed, Dubai did not make any exceptions. It gave me the sense of the most utopian city version today, where a dedicated Government can easily make decisions, initiate PPPs and develop its strategy*. Urban planning (like open space development) is simple for Dubai due to plenty of space.

Definition

With regard to definition, Dubai is a unique case that establishes many of the smart city promises. *Although Wi-Fi and Apps were not available to me, all the buildings and the systems I saw offer cutting-edge technology for access and navigation support*. In ecological terms, many open spaces exist, even green spaces in the desert and a manageable traffic size can be experienced. Interventions are necessary with regard to sustainable mobility, since walking is feasible only specific periods during the year, while the existing metro network covers only parts of the city.

Sustainability

Dubai has experienced a fiscal crisis lately, but it gave the sense that it has recovered. Efficient smart technology can be seen in buildings, which provide you with access and navigation support, but which have been deployed mainly by the private sector. I could say that only climate limitations exist in Dubai, which

[159]https://dubaifutureaccelerators.com/en.
[160]http://www.dubai-metro.me/.

disable much of the sustainable mobility options (walking and cycling) for half of the year, since available funding is proved to deliver almost all kinds of smart solutions to the public. Smart Dubai is mainly based on a dedicated government effort, which highly relies on the private sector for almost all initiatives (planning, marketing, management and deployment). Moreover, Dubai has launched an interesting business accelerator, which supports with funding and guidance innovation development. All the above confirm Dubai's potential to enhance its smart agenda in the forthcoming period.

The fringes

During my visit, I realized the meaning of a monarchy system. You feel safe against crime and car-accidents, you realize the difference between citizens and residents, while the government has the power to deploy any type of strategy and solution. Nevertheless, government pays much attention to public service deployment and measuring end-user satisfaction with the happiness index. *I can't tell at the moment, whether this happiness index delivers accurate information for a "happy" community, due to the strong differences between local social classes but it definitely helps the government to deliver its services to the community.* Dubai appears to be a successful smart city story but like the Asian cases, *I feel that technology is another city's asset in the international race, where Dubai has an outstanding performance as an attractive economic center and a well-organized administration. I can't confirm that it concerns the smartest city on earth, but the most futuristic one, for sure.*

3.4.13 The Case of Kyoto

Kyoto has a long smart history and is one of the oldest cases that appeared in literature: Ishida and Isbister (2000), Ishida (2002), Tanabe et al. (2002), van den Besselaar and Koizumi (2003), Ishida et al. (2005) are some of the primary works that discuss the case of Digital City Kyoto. According to this evidence, Digital City Kyoto concerned a case where urban information was collected and integrated real-time and people could interact and share knowledge, experiences, and mutual interests.

Digital City Kyoto was launched in 1998 and it was based on a strong connection between the physical city and the virtual world, which resulted to not an imaginary city, but instead to a version where digital city complements the corresponding physical city, and provides an information center for daily life for actual urban community. This policy resulted to an environment where, digital activities became parts of the real city, while several sensors collected information from the city (bus schedules, traffic status, weather condition and live video from points of interest) in an attempt to provide a tool for viewing and reorganizing digital activities created by people in the city. The above approach resulted to a virtual environment, where users were represented by avatars and could transact with objects that are parts of the real-world. The digital city was highly based on GIS information, while local websites (restaurants, schools, temples, shopping centers etc.) were allocated to XY coordinates. Transactions between users and the digital city were based on a 3D interface, which simplified even visitors to realize the overall urban environment. Some indicative use cases that were simulated in the digital city concerned bus trip identification; park space location; restaurant table's reservation; sales' determination at a store etc. Some more services concerned virtual bus tours and chat between the users. Digital city Kyoto was a pioneer and successful endeavor, which ended in 2004 and no more evidence with regard to its continuity appears in literature, which questions the reason of this abandonment. In terms of organization, the project was an initiative sponsored by NTT and housed in the new NTT Open Laboratory.

Kyoto was the capital of Japan for more than a thousand years, and has been a cultural center of Japan for even longer. The official websites,[161,162] provide the citizen, visitor and business with several information and services. A plenty of information is available for touristic activities, which show that the city is an attractive place for visitors due to its long history and numerous monuments. With regard to its smart strategic planning, only a few references can be located: UN Habitat (2006) presents a collaborative city planning that took place in Kyoto, for both old and new city sections (Kyoto city 2007); smart city initiatives in Japan (Pham 2014) describe the smart and green development of Keihanna district in Kyoto (also called Kansai Science City[163]) in 1980s, with the aim of fostering research activities in culture and mostly science; Kyoto has released several datasets,[164] while it will host the smart city expo in 2017[165]; several smart and green activities have been undertaken with the collaboration of the city with alternative companies like for energy efficiency and emission control and for the development of an e-bus network etc. (Pham 2014).

I visited Kyoto on December 6, 2016 right before chairing a special track in smart cities for the purposes of CEDEM ASIA 2016[166] *conference, in Daegu, South Korea. The purpose of this visit was to realize what happened with Digital City Kyoto right after its completion and more specifically, whether it had just accomplished its mission or it has been upgraded to a smart city case. In this regard, I had arranged a meeting with the developer and responsible scholar for Digital City Kyoto, professor Toru Ishida, who thankfully accepted my request. The meeting venue was scheduled to be inside Kyoto University's campus.*

---

[161]http://www.city.kyoto.lg.jp/.

[162]http://www.pref.kyoto.jp/.

[163]http://www.kri-p.jp/english/index.html.

[164]https://data.city.kyoto.lg.jp/.

[165]http://expo.smartcity.kyoto/.

[166]https://smartcitytrack.wordpress.com.

Fig. 3.63 A representative view of the city

I arrived in Kyoto the same day in the evening, via *the Shinkansen train*[167] *connection from Tokyo. Arriving in Kyoto was an extremely easy process, since frequent train connections exist with Tokyo*. The train station was accessible to a visitor, with signs to go everywhere in the city, information desks and maps to support you. Moreover, an open city Wi-Fi network, entitled Kyoto Wi-Fi, was available and accessing it was simple and free-of-charge. The train station was connected to the subway network, which charges you with fixed-rates according to your destinations. Issuing a ticket was very easy process too and it took me about 15 min to go to my hotel, located downtown. The primary sense that Kyoto gave me was that it was a very accessible and sustainable city, in terms of transportation and open spaces (Fig. 3.63). Moreover, the community was used to tourists and people were helpful and willing to assist you locating your destination.

I used a taxi to get to the meeting venue in order not to be late in my meeting. The weather was cool—something normal since the city is located close a mountain area—and during my trip in the city I enjoyed wide avenues, sidewalks, numerous of temples and old districts (Fig. 3.64). *My interviewee was already there waiting for me and our discussion lasted approximately 2 h*. Professor Ishida explained me the history of Kyoto and of the Digital City Kyoto and his sayings matched completely the literature evidence. *He described me the initial success of the case and that it was only a digital city's prototype and indeed a pioneer project*. Nevertheless, neither the city nor the involved stakeholders wanted to keep on its operation after project completion, so the project stopped (Ishida 2005). He also discussed how the international interest to smart city moved mainly to the physical world, instead to the cyberspace where Digital City Kyoto belonged, although it had strong connections with the real world and performed sensing, back that time.

---

[167] https://shinkansen-ticket.com.

Fig. 3.64 A representative view of a temple in Kyoto

Scale

Digital City Kyoto was a small-scale project, which lasted 6 years, but at its time it was extremely innovative and had to overcome many complexities (i.e., map websites from the real-world with XY coordinates on a map). Nevertheless, the city of Kyoto contains several smart services available to the public (i.e., intelligent public transportation networks, metro Wi-Fi etc.), while it has followed strategic plans to become a green and smart city. The overall experience showed how well the private and public sectors in Japan work together on common missions.

Definition

Digital City Kyoto combines the features of a digital city (networks and information system), of a virtual city (a 3D interface was used to access its environment) and the smart city (sensors transferred data from the physical to the virtual world). In this respect, Digital City Kyoto was one of a kind. Today, Kyoto follows strategic visions to become a green and smart city, with features that combine innovation and smart service deployment in the city.

Sustainability

In terms of environmental performance, I experienced plenty of open space in Kyoto and an effective transportation network that enables sustainable mobility. Digital City of Kyoto ended its lifecycle and did not retain its operation due to the lack of stakeholders' interest. As Ishida (2002) claimed, someone with love to his city can develop several outcomes, which perform even better compared to many official efforts. The city continues its effort to become green and smart in terms of environmental performance and service delivery. *When the next day I had to travel to Osaka airport, since I had to leave and attend CEDEM ASIA 2016, I experienced more smart transportation services, which concerned bus smart signs and ticket issuing machines for long trips. According to my interviewee*, the only threat to

Kyoto could be the emerging sharing economy, which enables asset sharing to foreigners, a fact that could affect the traditional local character of the city.

The fringes

Ishida (2002) predicted that Digital Cities would evolve according to the Internet and technological—in general—evolution, which would transform their performance and behavior. Moreover, Ishida (2002) estimated that both profit and nonprofit services would be offered by the digital cities: profit services would secure digital city's sustainability and transform the digital city to a city's portal; nonprofit services would ensure digital city's differentiation across the globe instead of a common and homogenized version. Digital City Kyoto did not gain the appropriate interest (Ishida 2005) and ended after closing its lifecycle. Nevertheless, these predictions have become a reality nowadays and it remains to see whether the forthcoming *sharing city* could be initiated again from Kyoto, like it happened back in late 1990s. It would be normal for the Japanese innovation performance and the strong connection between the triple helix (Government, University and the Industry). Kyoto appears to have the four helixes at a harmonized connection, since the local community looked very collaborative and fluent in transacting with smart services.

3.4.14 Discussion

The above research methodologies return useful findings for each of the examined cases and for all the examined cases simultaneously (Table 3.12). Smart city is first a city, whose performance mainly is based on urban infrastructure, facilities and city planning. Thus, if the city has sufficient utilities (e.g., public transportation) and strong economic capacity (like London, New York, Dubai and Hong Kong etc.), it performs good and offers opportunities regardless its intelligent facilities. Moreover, if the city has followed sustainable planning, contains enough open spaces and ensures citizen satisfaction, it is more likely to become a livable city (e.g., Melbourne, Kyoto, Vienna and New Songdo).

On the other hand, smartness has been recognized as innovation not necessarily (e.g., the smart bins in London) but mainly based on the ICT. In this respect, a city could be considered smart, even if it has no ICT-based infrastructure or services but it serves local needs with intelligence (e.g., Geneva). This innovation aims to improve local living against the identified challenges but, even the visit to the "tomorrow city" of New Songdo does not give someone the sense of living in the future and it is more likely for residents to experience updated or fully automated typical services (i.e., waste collection, home's remote control and heating systems). However, this journey provided with the difference of the experience that a visitor gains by a smart city in practice, compared to the expectations that marketing or reporting may generate and each case concerns a different paradigm.

Table 3.12 Findings from the investigated cases

	Case	Start	Literature evidence	Official website findings	Interview findings
1.	Trikala	2003	Anthopoulos and Tsoukalas (2006), Mizaras (2008)	1. Public information for residents and visitors The strategic plan "Trikala 2025" (only in Greek) http://www.trikalacity.gr 2. Smart city of Trikala project description: http://www.e-trikala.gr	Empirical findings: 1. Project awarded as the first Greek smart city in 2004 2. Smart city declined in 2009 3. Mainly a focus on smart transportation and smart care 4. Project aims to restart before 2017 5. Today the city mostly participates in European project consortiums
2.	Tampere	2001	Viteli (2005), Ergazakis et al. (2011)	3. Information and public services for residents, visitors and businesses https://www.e-tampere.fi/english/ 4. Smart city strategy: https://yritystampere.fi/en/smart/smart-city • *New Districts: Vuores, Tesoma, city center's renovation* • *city's open innovation platforms* • *smart lighting and eco-mobility* • *service digitalization; health technology of the future; and industrial Internet* 5. **Open data** (http://www.tampere.fi/tampereen-kaupunki/tietoa-tampereesta/avoin-data.html)	1. Project ended in 2005 2. Emphasis on partnership with local universities 3. More than 1000 freelancers in digital economy

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
3.	Geneva	1994	Van Bastelaer (1998)	1. Information for residents, visitors and businesses http://www.ville-geneve.ch/ 2. Pioneering quantum telecommunications network for R&D purposes: http://swissquantum.idquantique.com/ 3. Services Industriels de Genève (LSIG), Geneva-MAN, FTTH and smart-grid operator http://www.sig-ge.ch/en 4. Strategic programme for sustainable development 2011–2014 (City of Geneva 2010) 5. Service Agenda 21 Ville Durable (City of Geneva 2014) • *Enhance local sustainability in terms of environmental protection, equity, local economic growth and citizen engagement*	1. Geneva-MAN failed to secure social acceptance in 2003 2. An updated FTTH network would be deployed in partnership with the private sector until 2015 3. SWISS Fibre Net foundation in 2009 to operate the networks (http://www.swissfibrenet.ch) 4. SWISS Telecoms (the National Telecommunications Provider) will offer voice, data and content services 5. Orange Telecoms (national Mobile Operator) will offer mobile services
4.	Seoul	2009	Cities Alliance (2014, 2015), Yigitcanlar and Lee (2014), Lee et al. (2014), An and Kim (2015)	1. Information and public services for residents, visitors and businesses Seoul Master Plan 2030 http://english.seoul.go.kr/ 2. **Open data** (http://data.seoul.go.kr/) 3. Gangnam-gu ubiquitous district http://www.koreaittimes.com/story/20769/smart-city-gangnam-gu%E2%80%99s-e-government-strategy	

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
5.	New Songdo	2001	Kim (2010), Lee et al. (2013), Yigitcanlar and Lee (2014), Shwayri (2013), Söderström et al. (2014)	1. Case's marketing to attract new residents, visitors and businesses: http://songdoibd.com/ 2. Public information for residents, visitors and businesses http://english.incheon.go.kr/index.do 3. Embedded smart waste management system: http://www.bbc.com/news/technology-23757738 4. Incheon Free Economic Zone description and benefits: http://www.ifez.go.kr/ 5. The ubiquitous city program of South Korea, according to the National Information Society Agency (NIA 2007): http://eng.nia.or.kr/ 6. New cities/districts projects by POSCO construction partner (POSCO 2015) 7. Telecommunications partner (CISCO)'s approach in New Songdo case: http://www.fastcompany.com/1514547/ciscos-big-bet-new-songdo-creating-cities-scratch 8. Marketing videos by the project coalition: https://www.youtube.com/watch?v=fHO_zkHPTaI 9. The New Songdo case as a city-in-a-box product: http://archis.org/publications/volume-34-city-in-a-box/ 10. Foreign universities are installed in Songdo: http://blogs.wsj.com/korearealtime/2011/07/14/songdo-suny/	1. Explanation of the sustainable city's and buildings' planning 2. Brief analysis of different types of smart services (e.g., smart waste management) 3. A different approach had been followed by the south Korean partners for cases' extension

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
6.	Vienna	2011	Cohen (2012), Madreiter and Haunold (2012), Gaiddon et al. (2016), He et al. (2015)	1. Public information and services for residents, businesses and visitors: https://www.wien.gv.at/english/ *Public Wi-Fi spots* *Mobile applications*: *Handy Parken: guide for parking space location* *Qando Wien: city guide* *Car2Go: car-sharing service and* *Uber: driver locating service* 2. **Open data**: https://open.wien.gv.at/site/open-data/ 3. Strategy for smart Vienna 2050: https://smartcity.wien.gv.at/site/en/initiative/rahmenstrategie/ 4. Smart city project demonstration (Vienna City Administration, 2014) *New district development: Seestadt Aspern* (Siemens 2015) *Existing district renovation: Simmering* *Education and Research; Health and Social Services; Building Activity and Living; Transportation and Urban Planning; Environment and Climate Protection; People and Society; and Politics and Administration/ICT* https://smartcity.wien.gv.at/site/en/projekte/ 5. Smart city initial project portfolio: *Innospirit for urban technology enhancement*; *CLUE for climate neutral and resource-conserving urban district development;* *Transform with regard to low carbon city transformation* http://ww2.tinavienna.at/en/referenceprojects/smartcity	1. Explanation of the role of the project management office: define common guidelines and rules for all city stakeholders in their corresponding smart city initiatives 2. Historical evidence of smart Vienna

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
7.	London	2013	Cohen (2012), Batty (2013), Mulligan and Olson (2013), Gabrys (2014), Lee et al. (2014)	1. Public information and services for residents, visitors and businesses, Smart London Board definition http://www.cityoflondon.gov.uk/Pages/default.aspx 2. Open data: http://data.london.gov.uk/ 3. Smart London Innovation Networks (SLINs) http://smarterlondon.co.uk/ 4. Mobile apps: http://www.visitlondon.com/traveller-information/getting-around-london/london-maps-and-guides/apps and http://www.buschecker.com/app/LON/	*Moments from the 3rd Ovum Smart-To-Future Cities 2014 regarding London*: 1. Smart bins without embedded ICT (http://www.smartstreets.co.uk/) 2. The foundation of the Smart London Board 3. The utilization of BSI standards for planning and management
8.	Washington DC	1992	Cavallo et al. (2014), Desouza and Flanery (2013), Herrschel (2013), Davies and Msengana-Ndlela (2014)	1. Public information and services for residents, visitors and government officials: http://dc.gov/ 2. Open data: http://opendata.dc.gov/ 3. The PA2040 project in Washington: http://octo.dc.gov/page/pa2040-project 4. World Bank and smart cities: http://blogs.worldbank.org/category/tags/smart-cities 5. The kick-off of NIST global city teams challenge: http://www.nist.gov/cps/global-city-teams-challenge-workshop.cfm	NIST Kick-off meeting of global cities challenge: 1. Sensor-based LED streetlights across the Pennsylvania Avenue (PA2040—http://octo.dc.gov/page/pa2040-project) Interview at the World Bank: 1. The World Bank partners—mostly—with governments in developing countries with regard to smart city projects (e.g., innovate technology and mobility solutions: Smart City Gran Concepción in Chile) 2. Organizes initiatives and workshops for smart solution providers' engagement

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
9.	NYC	2007	Pearsall (2013), Cavallo et al. (2014)	1. Public information and services for residents, visitors and businesses New York City by 2030 Strategic plan (PlaNYC 2030) (NYC 2007) and "Building a Smart + Equitable City" (NYC 2015) plans http://www.nyc.gov 2. Open data: https://nycopendata.socrata.com/ 3. Open APIs: https://developer.cityofnewyork.us/ 4. LinkNYC Municipal Wi-Fi network: https://link.nyc/	Smart city of NYC: 1. It is based on more than 60 data centers 2. It serves more than 300,000 civil employees 3. Multi-tier architecture 4. Focus on security and cyber-attacks 5. Sensors' deployment for environmental monitoring 6. More than 3000 new companies in data economy
10.	Hong Kong	1998	Neirotti et al. (2014), Angelidou (2014), Vojnovic (2014)	1. Public information and services for residents, visitors and businesses Environmental Impact Assessment (EAI) process Smart waste management Local business forum http://www.gov.hk/ 2. Government apps like the MyGovHK (CPU 2015): http://www.personalised.gov.hk 3. **Open data**: https://data.gov.hk/en/ 4. Digital 21 strategy (Commerce and Economic Development Bureau 2013) http://www.digital21.gov.hk/eng/index.htm 5. Real time traffic information: http://traffic.td.gov.hk/selection_e.htm 6. Route identification: http://hkerouting.gov.hk	Digital 21 story: 1. Blueprints for Hong Kong's ICT development 2. OGC: strategic planning and management 3. Project implementation with PPPs 4. Several projects regarding sensor and 20,000 Wi-Fi spots deployment, GovHK-MyGovHK web and mobile platforms and open data

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
11.	Melbourne	2010	Holden and Scerri (2013), Akçura and Avci (2014)	1. Public information and services for residents, visitors and businesses Smart city initiatives http://www.melbourne.vic.gov.au/ 2. **Open data**: https://data.melbourne.vic.gov.au 3. Energy efficiency and smart grid installation (Commonwealth of Australia 2009; AEFI 2014) 4. Melbourne City Council Plan 2013–2017 (City of Melbourne 2013)	Smart city Melbourne's story: 1. Government structure explanation and the role of City Council in the project 2. Initial smart city thinking after hosting a C40 Cities workshop http://www.cityofsound.com/files/c40_melbourne_report_final_email.pdf 3. Defining smart city with citizen engagement (design thinking process) 4. Living Lab foundation (City Lab) in collaboration of the city and 2 companies (Arup and CollabForge) Council Plan 2013–2017 decoding: 1. Open government and open data 2. Creative industry's enhancement 3. The city remains livable in terms of live/work/play

(continued)

Table 3.12 (continued)

	Case	Start	Literature evidence	Official website findings	Interview findings
12.	Dubai	1999	Lee and Oh (2008) NIA (2007), Al-Hader et al. (2009a, b), Lerner (2013), Mohammed et al. (2014), Kourtit et al. (2014), Perera et al. (2014), Efthymiopoulos (2016)	1. Public information and services for citizens, residents, visitors and businesses Smart city brief strategic description http://www.dubai.ae http://www.dsg.gov.ae 2. Dubai strategic plan 2021 http://www.dubaiplan2021.ae/ 3. Dubai wholesale city http://www.dubaiwholesalecity.ae/ 4. Dubai Smart City (Internet and Media cities) http://www.smartcity.ae/ 5. **Open data**: http://dubaidata.ae/	Smart Dubai's story: 1. Smart Dubai organization's clarification 2. Smart initiatives were launched in 2014 3. Exemplars: happy meter; app; and open data Dubai Strategy 2021 decoding: a. Happiness Agenda; b. Blockchain strategy; c. 2021 roadmap
13.	Kyoto	1998	Ishida and Isbister (2000), Ishida (2002), Tanabe et al. (2002), van den Besselaar and Koizumi (2003), Ishida et al. (2005)	1. Public information and services for citizens, residents, visitors and businesses http://www.city.kyoto.lg.jp/ http://www.pref.kyoto.jp/ 2. **Open data**: https://data.city.kyoto.lg.jp/	Digital city Kyoto's story: 1. Validated literature evidence 2. The project started in 1998 and ended in 2004 3. Existing smart city efforts do not have connections with the past digital city

Another important finding concerns the relation between smart and livable city. All the examined cases and mainly the megacities (Seoul, New York, London, Hong Kong and Dubai) showed that smart infrastructure and services support their transformation to livable ones, in terms of local quality of life and citizen satisfaction but, it is hard for most of them (except Dubai) to achieve, due to their space limits and existing facilities. Additionally, urban innovation may contribute in maintaining a city livable (e.g., Melbourne, Vienna and Kyoto).

Furthermore, smart city enhances local economic capacity regardless the city size. The outcomes from Tampere and New York show that open innovation platforms and open data respectively can result to comparable job creations in the digital economy.

Additionally, all the examined cases followed corresponding planning, which may differ in targets' prioritization but in the end, they all target similar outcomes. Two objectives are quite "hidden" from strategic planning: establishing city monitoring and improving city's competition in terms of attracting new residents, enterprises and visitors. On the other hand, city's competitive advantages are not extremely updated via intelligence, but technology is another asset in the international race. Another important outcome is that the most successful cases (e.g., Tampere, Seoul, Vienna, London, NYC and Hong Kong) evolve with new or renovated districts.

Results depict that indeed the smart city is supported by extensive marketing and partnerships between cities and the private sector. However, smart city is more than a reality, which is useful for all the city types and sizes in their attempts to deal with common challenges. On the other hand, marketing alone cannot generate a smart city, but a city can be smart without "shouting" it (e.g., Washington and Geneva).

Finally, the planning that the examined cases follow provide with a picture of how smart cities evolve around the globe (Table 3.12): most cases have envisioned their future until 2020/2021 and they progress accordingly, while some (Tampere, Seoul and NYC) have envisioned their urban conditions by 2030 and only Vienna has defined its vision for 2050. The analysis shows that this progress is based on the following axes of precedence: open data release and digital economy's growth; embedded ICT infrastructure installation in existing facilities (e.g., FTTH and IoT); city monitoring with big data analytics; and districts construction or renovation with sustainable planning and cyber-physical integration (something that comes back from the story of Digital City Kyoto). In this regard, a brief view to the future smart city can be depicted.

3.5 Conclusions

This chapter attempted to present smart city in practice, after working in 4 complementary axes of precedence: first, to explore and briefly outline the smart technologies that are being applied today by smart city according to its definition and conception, justified by literature evidence. Then, it tried to investigate and summarize smart services that are being offered by an efficient number of smart cities according to their official websites. Next, it compared existing smart city standards in an attempt to realize how the alternative technologies can work together in achieving smart city purposes. Finally, learning from experience comes to close this presentation: 13 smart city cases are analyzed and briefly presented with regard what it is written about them in literature, what the cities claim to happen and what a walk in the city returns as an experience.

The underlying purpose of this chapter was to distinguish theory and practice in the smart city domain and support the reader to take a full picture of the competitive and complementary technologies that are being combined in a smart city. Technology, standards and practices distinguish "smart utopia" from "smart reality" and validates that the cities exist and they can be supported by technology in order to enhance local living.

Revision Question 1:	what does smart utopia mean?
Revision Question 2:	which 2 forces drive the smart city development?
Revision Question 3:	compare 2 particular smart city cases.
Revision Question 4:	why is the walk within the city helpful to realize a smart city?
Revision Question 5:	what does the case of London teach us regarding initiating a smart city project?
Revision Question 6:	how different the case of Vienna is compared to others?
Revision Question 7:	why did e-Trikala decline? What appear to be the recovery solutions?
Revision Question 8:	do you think Songdo concerns a successful story? Justify.
Revision Question 9:	is Washington DC a smart city case? Justify.
Revision Question 10:	how would you summarize the particularities of NYC case?
Revision Question 11:	why did Geneva-MAN fail?
Revision Question 12:	is smart city a Tampere a success story? Justify.
Revision Question 13:	summarize the story of Hong Kong.
Revision Question 14:	what is the relation between smart and livable city? What does the story of Melbourne tell us in this regard?
Revision Question 15:	why could Dubai be considered a futuristic smart city?
Revision Question 16:	why did Digital City Kyoto stop?

References

Abdellatif, M., & Al-Shamma'a, A. (2015). Review of sustainability in buildings. *Sustainable Cities and Society, 14,* 171–177.

Akçura, M. T., & Avci, S. B. (2014). How to make global cities: Information communication technologies and macro-level variables. *Technological Forecasting and Social Change, 89,* 68–79.

Al-Hader, M., Rodzi, A., Sharif, A. R., & Ahmad, N. (2009a). Smart city components architecture. In *Proceedings of the 2009 International Conference on Computational Intelligence, Modelling and Simulation.* IEEE.

Al-Hader, M., Rodzi, A., Sharif, A. R., & Ahmad, N. (2009b). SOA of smart city geospatial management. In *Proceedings of the Third UKSim European Symposium on Computer Modeling and Simulation, 2009. EMS '09.* IEEE.

Allcott, H., & Greenstone, M. (2012). Is there an energy efficiency gap? *The Journal of Economic Perspectives*, *26*(1), 3–28(26).

Allwinkle, S., & Cruickshank, P. (2011). Creating Smart-er cities: An overview. *Journal of Urban Technology, 18*(2), 1–16.

American National Standards Institute (ANSI). (2016). *ANSSC directory of smart and sustainable cities standardization initiatives and related activities report*. Retrieved August 2016 from https://share.ansi.org/ANSI%20Network%20on%20Smart%20and%20Sustainable%20Cities/ANSSC-Directory-of-Initiatives.pdf

Amiri, M., & Sadeghpour, F. (2014). Cycling characteristics in cities with cold weather. *Sustainable Cities and Society, 14,* 397–403.

An, J., & Kim, J. (2015). 2030 Seoul Plan: Urban foresight focusing on reflexive governance and resilience. In *Proceedings of the 8th Conference of the International Forum on Urbanism (IFoU)* (pp. 354–369). Incheon, South Korea, C013. doi:10.3390/ifou-C013

Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities, 41,* S3–S11.

Anthopoulos L. (forthcoming). A standardized smart city: the case of Trikala. One of the selected cases of the European 2016 campaign, In *Proceedings of the 9th European Quality Conference (9QC)*. May 15–16, 2017 Malta.

Anthopoulos, L. (2017). Smart Utopia VS smart reality: Learning by experience from 10 smart city cases. *Cities, 63,* 128–148.

Anthopoulos, L., & Fitsilis, P. (2013). Using classification and roadmapping techniques for smart city viability's realization. *Electronic Journal of e-Government, 11*(1), 326–336. ISSN1479-439X.

Anthopoulos, L., & Fitsilis, P. (2014). Trends in e-strategic management: How do governments transform their policies? *International Journal of Public Administration in the Digital Age, 1* (1), 15–38.

Anthopoulos, L., Janssen, M., & Weerakkody, V. (2016). Smart service portfolios: Do the cities follow standards? In *Proceedings of the AW4City 2016 Workshop, in Conjunction with the WWW2016 ACM 25th World Wide Web International Conference*. April 11, 2016, Montreal, Canada. doi:10.1145/2872518.2888618

Anthopoulos, L., & Reddick, Ch. (2015). Understanding electronic government research and smart city. *Information Polity, 21*(1), 99–117. doi:10.3233/IP-150371

Anthopoulos, L., & Tsoukalas, I. A. (2006). The implementation model of a digital city. The case study of the first digital city in Greece: e-Trikala. *Journal of e-Government, 2*(2), 91–109.

Arup, Energeia, Frontier Economics, Institute for Sustainable Futures (AEFI). (2014). *Smart grid, smart city: Shaping Australia's energy future*. Retrieved, August 2016 from http://industry.gov.au/Energy/Programmes/SmartGridSmartCity/Documents/SGSC-Executive-Report-National-Cost-Benefit.pdf

Batty, M. (2013). Big data, smart cities and city planning. *Dialogues in Human Geography, 3*(3), 274–279.

Bellini, P., Benigni, M., Billero, R., Nesi, P., & Rauch, N. (2014). Km4City ontology building vs data harvesting and cleaning for smart-city services. *Journal of Visual Languages and Computing, 25,* 827–839.

Bertini, R. L., Monsere, C. M., & Yin, T. (2005). Benefits of intelligent transportation systems technologies in urban areas: A literature review. Portland State University Report. Retrieved August 2016 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.296.3448&rep=rep1&type=pdf

Boutsis, I., Kalogeraki, V., & Gunopoulos, D. (2016). Reliable crowdsourced event detection in smartcities. In *Proceedings of the 1st International Workshop on Science of Smart City Operations and Platforms Engineering (SCOPE) in partnership with Global City Teams Challenge (GCTC) (SCOPE—GCTC)*, Vienna.

Breheny, M. (1995). The compact city and transport energy consumption. *Transactions of the Institute of British Geographers, 20*(1), 81–101.

British Standards Institute (BSI). (2014). *PAS 181 smart city framework standard*. Retrieved July 2016 from http://www.bsigroup.com/en-GB/smart-cities/Smart-Cities-Standards-and-Publication/PAS-181-smart-cities-framework

British Standards Institute (BSI). (2016). *Mapping smart city standards: Based on a data flow model*. Retrieved August 2016 from http://www.bsigroup.com/en-GB/smart-cities/smart-cities-standards-mapping-research-and-modelling/

Brown, L. A. (2014). The city in 2050: A kaleidoscopic perspective. *Applied Geography, 49,* 4–11.

Caprotti, F. (2014). Critical research on eco-cities? A walk through the Sino-Singapore Tianjin Eco-City, China. *Cities, 36,* 10–17.

Cardone, G., Corradi, A., Foschini, L., & Ianniello, R. (2015). Participact: A large-scale crowdsensing platform. *IEEE Transactions on Emerging Topics in Computing, 4*(1), 21–32.

Cavallo, S., Lynch, J., & Scull, P. (2014). The digital divide in citizen-initiated government contacts: A GIS approach. *Journal of Urban Technology, 21*(4), 77–93.

CEN-CENELEC-ETSI. (2015). *Smart and sustainable cities and communities coordination group final report*. Retrieved August 2016 from http://www.cencenelec.eu/standards/Sectors/SmartLiving/smartcities/Pages/SSCC-CG.aspx

CEN-CENELEC-ETSI. (2016). *Smart and sustainable cities and communities: A role for European standardization*. Retrieved July 2016 from http://www.cencenelec.eu/News/Publications/Publications/Smart_cities.PDF

Central Policy Unit (CPU), The Government of Hong Kong Special Administrative Region. (2015). *Research report on smart city*. Retrieved August 2016 from http://www.cpu.gov.hk/doc/en/research_reports/CPU%20research%20report%20-%20Smart%20City(en).pdf

Cherubini, F., Bargigli, S., & Ulgiati, S. (2008). Life cycle assessment of urban waste management: Energy performances and environmental impacts. The case of Rome, Italy. *Waste Management*, *28*, 2552–2564.

China Academy of Information and Communications Technology (CAICT) and EU-China Policy Dialogues Support Facility II (PDSF). (2014). *Comparative study of smart cities in Europe and China 2014*. Heidelberg: Springer.

Chinrungrueng, J., Sunantachaikul, U., & Triamlumlerd, S. (2007). Smart parking: An application of optical wireless sensor network. In *IEEE Proceedings of the 2007 International Symposium on Applications and the Internet Workshops (SAINTW'07).*

CISCO. (2012). *Smart city framework: A systematic process for enabling smart + connected communities*. Retrieved August 2016 from http://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/motm/Smart-City-Framework.pdf

CISCO. (2013). *Connections counter: The internet of everything in motion*. Retrieved August 2016 from https://newsroom.cisco.com/feature-content?articleId=1208342

Cities Alliance. (2014). *"Owl bus" based on big-data technology*. Retrieved August 2016 from http://www.citiesalliance.org/solutions-from-seoul

Cities Alliance. (2015). TOPIS: The control tower for Seoul's intelligent transportation system. Retrieved August 2016 from http://www.citiesalliance.org/solutions-from-seoul

City of Geneva (2014). Service agenda 21—Ville durable rapport d'activités 2014. Retrieved August 2016 from http://www.ville-geneve.ch/fileadmin/public/Departement_1/Publications/Rapport_d_activites_2014_Service_A21_version_validee.pdf

City of Geneva. (2010). *Strategic plan for sustainable development of the city of Geneva 2011–2014*. Retrieved August 2016 from http://www.ville-geneve.ch/fileadmin/public/Departement_1/Documents_d_actualite/strategic-plan-for-the-sustainable-development-of-the-city-of-Geneva-2011-2014-target-setting-report-2011-ville-de-geneve.pdf

City of Melbourne. (2013). *Melbourne city Council Plan 2017*. Retrieved August 2016 from http://www.melbourne.vic.gov.au/SiteCollectionDocuments/council-plan-2013-17.pdf

City of Tampere. (2014). *Smart Tampere*. Retrieved August 2016 from http://www.esitteemme.fi/smart_tampere.pdf

Cohen, B. (2012). *The top 10 smart cities on the planet, CoExist, 17 January*. Retrieved August 2016 from http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet

Commerce and Economic Development Bureau. (2013). *Smarter Hong Kong, smarter living*. Retrieved August 2016 from http://www.digital21.gov.hk/eng/relatedDoc/download/2014D21S-booklet.pdf

Commonwealth of Australia. (2009). *Smart grid, smart city: A new direction for a new energy era*. Retrieved August 2016 from http://www.industry.gov.au/Energy/Documents/smart-grid/smartgrid-newdirection.pdf

Cosgrave, E., Arbuthnot, K., & Tryfonas, T. (2013). Living labs, innovation districts and information marketplaces: A systems approach for smart cities. *Procedia Computer Science, 16,* 668–677.

Cugurullo, F. (2013). How to build a sandcastle: An analysis of the genesis and development of Masdar City. *Journal of Urban Technology, 20*(1), 23–37.

Davies, J. S., & Msengana-Ndlela, L. G. (2014). Urban power and political agency: Reflections on a study of local economic development in Johannesburg and Leeds. *Cities, 44,* 131–138.

Desouza, K. C., & Flanery, T. H. (2013). Designing, planning, and managing resilient cities: A conceptual framework. *Cities, 35,* 89–99.

DKE/DIN. (2014). *The German standardization roadmap—Version 1.0*. Retrieved August 2016 from https://www.dke.de/de/std/documents/nr_smart%20city_en_version%201.0.pdf

Duckett, G. A. (2016). *Data science: Questions and answers*. CreateSpace Independent Publishing Platform

Efthymiopoulos, M.-P. (2016). Cyber-security in smart cities: the case of Dubai. *Journal of Innovation and Entrepreneurship, 5,* 11. doi:10.1186/s13731-016-0036-x.

Ergazakis, E., Ergazakis, K., Askounis, D., & Charalabidis, Y. (2011). Digital cities: Towards an integrated decision support methodology. *Telematics and Informatics, 28,* 148–162.

European Telecommunications Standards Institute (ETSI). (2016). *Intelligent transport systems*. Retrieved August 2016 from http://www.etsi.org/technologies-clusters/technologies/intelligent-transport

Farkas, K., Feher, G., Benczur, A., & Sidlo, C. (2015). Crowdsending based public transport information service in smart cities. *IEEE Communications Magazine, 53*(8), 158–165.

Fan, M., Sun, J., Zhou, B., & Chen, M. (2016). The smart health initiative in China: The case of Wuhan, Hubei province. *Journal of Medical Systems, 40*(62), 4–17.

Gabrys, J. (2014). Programming environments: Environmentality and citizen sensing in the smart city. *Environment and Planning D: Society and Space, 32*(1), 30–48. doi:10.1068/d16812.

Gaiddon, B, Girardi, J., Neumann, H-M, Thielen, K., Vignali, E., & Wendt, W. (2016). *Three cities—Lyon, Munich, Vienna—will be SMARTER TOGETHER*. In *Proceedings of the 21st International Conference on Urban Planning and Regional Development in the Information Society GeoMultimedia 2016 (REAL CORP 2016)* (pp. 965–975). Hamburg, Germany.

Garcia, G. C., Ruiz, I. L., & Gomez-Nieto, M. (2017). State of the art, trends and future of BLE, NFC and VLC in the development of smart cities. *Sensors*, forthcoming.

Gauch, S., & Blind, K. (2015). Technological convergence and the absorptive capacity of standardization. *Technological Forecasting and Social Change, 91,* 236–249.

Giffinger, R. C., Fertner, H., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. (2007). *Smart cities: Ranking of European medium-sized cities*. Retrieved May 2016 from http://www.smart-cities.eu/download/smart_cities_final_report.pdf

Government of Ireland. (2008). *Building Ireland's smart economy. A framework for sustainable economic renewal*. Retrieved August 2016 from http://www.taoiseach.gov.ie/BuildingIrelandsSmartEconomy_1_.pdf

Hall, R. E. (2000). The vision of a smart city. In *Proceedings of the* 2nd *International Life Extension Technology Workshop*, Paris, France.

Hassan, M. M., Albakr, H. S., & Al-Dossari H. (2014). A cloud-assisted internet of things framework for pervasive healthcare in smart city environment. In *Proceedings of the 1st International Workshop on Emerging Multimedia Applications and Services for Smart Cities (EMASC)*, Orlando, Florida, U.S.A.

He, D., Orozco, J. S., Straus, M., Kovalenko, N., & Remezkova, V. (2015). Being a smart city: The case of Vienna and Seestadt Aspern. White Paper, Vienna, June 2015.

Herrschel, T. (2013). Competitiveness and sustainability: Can 'smart city regionalism' square the circle? *Urban Studies, 50,* 2332–2348.

Holden, M., & Scerri, A. (2013). More than this: Liveable Melbourne meets liveable Vancouver. *Cities, 31,* 444–453.

Hollands, R. (2008). Will the real smart city please stand up? *City, 12*(3), 303–320.

Hollands, R. G. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society, 8,* 61–77.

Holler, J., Tsiatsis, V., Mulligan, C., Avesand, S., Karnouskos, S., & Boyle, D. (2014). *From machine-to-machine to the internet of things*. Oxford, UK: Elsevier. doi:10.1016/B978-0-12-407684-6.00018-8

Homma, S. & Hu, J.-L. (2008). Total-factor energy efficiency of regions in Japan. *Energy Policy*, *36*, 821–833.

Hu, M., & Chang, L. (2012). Design smart city based on 3S, internet of things, grid computing and cloud computing technology. In *Proceedings of the International Workshop in Internet of Things (IOT 2012)* (pp. 446–472), Changsha, China, CCIS 312.

Hu, J.-L., & Wang, S.-C. (2006). Total-factor energy efficiency of regions in China. *Energy Policy, 34,* 3206–3217.

IEEE. (2014). *P2413—Standard for an architectural framework for the internet of things (IoT)*. Retrieved August 2016 from http://standards.ieee.org/develop/project/2413.html

International Electrotechnical Commission (IEC). (2014). *Orchestrating infrastructure for sustainable smart cities*. Retrieved August 2016 from http://www.iec.ch/whitepaper/pdf/iecWP-smartcities-LR-en.pdf

International Electrotechnical Commission (IEC). (2016). *Smart cities*. Retrieved August 2016 from http://www.iec.ch/about/brochures/pdf/technology/smartcities.pdf

International Standards Organization (ISO). (2015). *Smart community infrastructures—Principles and requirements for performance metrics*. Retrieved August 2016 from https://www.iso.org/obp/ui/#iso:std:iso:ts:37151:ed-1:v1:en

International Standards Organization (ISO). (2016). *Sustainable development in communities*. Retrieved August 2016 from http://www.iso.org/iso/iso_37101_sustainable_development_in_communities.pdf

International Standards Organization (ISO). (2014a). *ISO 37120:2014: Sustainable development of communities—Indicators for city services and quality of life*. Retrieved August 2016 from https://share.ansi.org/ANSI%20Network%20on%20Smart%20and%20Sustainable%20Cities/ISO%2B37120-2014_preview_final_v2.pdf

International Standards Organization (ISO). (2014b). *Smart cities preliminary report 2014*. Retrieved August 2016 from http://www.iso.org/iso/smart_cities_report-jtc1.pdf

International Standards Organization (ISO). (2014c). *Smart community infrastructures*. Retrieved August 2016 from http://www.iso.org/iso/executive_summary_iso_37150.pdf

International Telecommunications Union (ITU). (2007). *Intelligent transport systems and CALM*. Retrieved July 2016 from https://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000010003PDFE.pdf

International Telecommunications Union (ITU). (2014a). *Smart water management in cities*. Retrieved July 2016 from http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

International Telecommunications Union (ITU). (2014b). *Overview of smart sustainable cities infrastructure*. Retrieved July 2016 from http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

International Telecommunications Union (ITU). (2014c). *Intelligent sustainable buildings for smart sustainable cities*. Retrieved August 2016 from http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

International Telecommunications Union (ITU). (2014d). *Anonymization infrastructure and open data in smart sustainable cities*. Retrieved August 2016 from http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

Ishida, T. (2002). Digital city Kyoto. *Communications of the ACM, 45*(7), 76–81.

Ishida, T. (2005). Activities and technologies in digital city Kyoto. In P. van den Besselaar & S. Koizumi (Eds.), *Digital cities 2003, LNCS 3081* (pp. 166–187). Berlin Heidelberg: Springer.

Ishida, T., Aurigi, A., & Yasuoka, M. (2005). World digital cities: Beyond heterogeneity. In P. van den Besselaar & S. Koizumi (Eds.), *Digital cities 2003, LNCS 3081* (pp. 188–203).

Ishida, T., & Isbister, K. (2000). *Digital cities: Experiences, technologies and future perspectives*. Berlin Heidelberg: Springer.

Kanada, M., Fujita, T., Fujii, M., & Ohnishi, S. (2013). The long-term impacts of air pollution control policy: Historical links between municipal actions and industrial energy efficiency in Kawasaki City, Japan. *Journal of Cleaner Production, 58,* 92–101.

Kim, C. (2010). Place promotion and symbolic characterization of New Songdo City, South Korea. *Cities, 27*(1), 13–19.

Kourtit, K., Deakin, M., Caragliu, A., Del Bo, C., Nijkamp, P., Lombardi, P., et al. (2014). An advanced triple helix network framework for smart cities performance. In M. Deakin (Ed.), *Smart cities: Governing, modelling and analysing the transition* (pp. 192–217). London and New York: Routledge.

Kyoto City. (2007). *Kyoto city landscape policy: Forming timeless and radiant Kyoto landscapes*. Retrieved March 2017 from http://whc.unesco.org/document/116517

Lee, S. (2011). Subsurface-data reasoning framework for natural disasters. *Applied Geomatics, 3*(4), 199–206.

Lee, J. & Oh, J. (2008). *New Songdo City and the value of flexibility: A case study of implementation and analysis of a mega-scale project.* Boston: Master of Science dissertation, MIT (Unpublished). Retrieved December 2011 from http://dspace.mit.edu/bitstream/handle/1721.1/58657/317296469.pdf?sequence=1

Lee, J. H., Hancock, M. G., & Hu, M.-C. (2014). Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. *Technological Forecasting and Social Change, 89,* 80–99.

Lee, J. H., Phaal, R., & Lee, S.-H. (2013). An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change, 80,* 286–306.

Lerner, J. (2013). The boulevard of broken dreams: Innovation policy and entrepreneurship. *Innovation Policy and the Economy, 13*(1), 61–82.

Lizarralde, G., Chmutina, K., Bosher, L., & Dainty, A. (2015). Sustainability and resilience in the built environment: The challenges of establishing a turquoise agenda in the UK. *Sustainable Cities and Society, 15,* 96–104.

Madreiter, T., & Haunold, V. (2012). Smart city Vienna: Sustainable success. In H. Widmann (Ed.), *Smart city: Viennese expertise based on science and research* (pp. 35–40). Vienna: Schmid Verlag.

Mizaras, V. (2008). Ancient and modern. On the modernisation of Greece's urban public transport system. *Thinking Highways, 3*(3), 64–67.

Mohammed, F., Idries, A., Mohamed, N., Al-Jaroodi, J., & Jawhar, I. (2014). UAVs for smart cities: Opportunities and challenges. In *Proceedings of the 2014 International Conference on Unmanned Aircraft Systems (ICUAS)*, Orlando, USA.

Moore, G. E. (1979). Standardization. *Microelectronics Journal, 10*(2), 30–34.

Mulligan, C. E. A., & Olsson, M. (2013). Architectural implications of smart city business models: An evolutionary perspective. *IEEE Communications Magazine, 51*(6), 80–85.

Mutuku, L. N., & Colaco, J. (2012). Increasing Kenyan open data consumption: A design thinking approach. In *Proceedings of the 5th International Conference on Electronic Governance (ICEGOV)*, Albany, NY, USA.

National Information Society Agency (NIA) of South Korea. (2007). *U-City*. Retrieved August 2016 from http://eng.nia.or.kr/english/bbs/download.asp?fullpathname=%5CData%5Cattach%5C201112221611231975%5Cu-City(2007).pdf&filename=u-City(2007).pdf

Neirotti, P., De Marco, A., Cagliano, A. C., Magnano, G., & Scorrano, F. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities, 38,* 25–36.

New York City (NYC). (2007). *PlaNYC: A greener, Great New York*. Retrieved, Aug. 2017 from http://www.nyc.gov/html/planyc/downloads/pdf/publications/full_report_2007.pdf

New York City (NYC). (2011). *Road map for the digital city*. Retrieved August 2017 from http://www.nyc.gov/html/media/media/PDF/90dayreport.pdf

New York City (NYC). (2015). *Building a smart + equitable city*. Retrieved August 2017 from https://www1.nyc.gov/site/forward/innovations/smartnyc.page

NIST. (2014). *Smart cities/CPS at NIST*. Retrieved July 2016 from http://www.nist.gov/public_affairs/releases/upload/smartcities_cps_budgetsheet.pdf

NIST. (2015). *Framework for cyber-physical systems: Draft Release 0.8*. Retrieved August 2016 from https://pages.nist.gov/smartcitiesarchitecture/community/consensusppi/

NIST. (2016). *IoT—Enabled smart city framework*. Retrieved July 2016 from https://s3.amazonaws.com/nist-sgcps/smartcityframework/files/IoT-EnabledSmartCityFrameworkWP.pdf

Office of the Government Chief Information Officer (OGC), Commerce and Economic Development Bureau, the Government of the Hong Kong Special Administrative Region. (2013). *Smarter Hong Kong, smarter living*. Retrieved August 2016 from http://www.digital21.gov.hk/eng/relatedDoc/download/2014D21S-booklet.pdf

Organization of Economic Cooperation and Development (OECD). (2013). *Water security for better lives*. Retrieved July 2016 from http://www.oecd.org/env/resources/watersecurity.htm

Otterpohl, R., Grottker, M., & Lange, J. (1997). Sustainable water and waste management in urban areas. *Water Science and Technology, 35*(9), 121–133.

Parks, W. (1957). Open government principle: Applying the right to know under the constitution. *The George Washington Law Review, 26*(1), 1–22.

Patil, C. S., & Pawar, K. N. (2016). A Review on: Protocols and standards in different application areas of IOT. *International Journal of Advanced Research in Computer and Communication Engineering, 5*(2), 163–168.

Pawlak, Z. (2002). In pursuit of patterns in data reasoning from data—The rough set way. In J. J. Alpigini et al. (Eds.), *Proceedings of Rough Sets and Current Trends in Computing, Third International Conference*, Lecture Notes in Computer Science (Vol. 2475, pp. 1–9). Malvern, PA, USA.

Pearsall, H. (2013). Superfund me: A study of resistance to gentrification in New York city. *Urban Studies, 50*(11), 2293–2310.

Perera, C., Zaslansky, A., Christen, P., & Georgakopoulos, D. (2014). Sensing as a service model for smart cities supported by internet of things. *Transactions on Emerging Telecommunications Technologies, 00,* 1–12. doi:10.1002/ett

Pham, C. (2014). *Smart cities in Japan: An assessment on the potential for EU-Japan cooperation and business development*. Retrieved March 2017 from http://cdnsite.eu-japan.eu/sites/default/files/publications/docs/smartcityjapan.pdf

POSCO. (2015). *POSCO E&C brochure*. Retrieved August 2016 from http://www.poscoenc.com/eng/pr/brochure.asp

Pyrga, E., Schulz, F., Wagner, D., & Zaroliagis, C. (2008). Efficient models for timetable information in public transportation systems. *ACM Journal of Experimental Algorithmics, 12* (2.4), 2–39.

Radulovic, D., Skok, S., & Kirincic, V. (2011). Energy efficiency public lighting management in the cities. *Energy, 36,* 1908–1915.

Ram, S., Wang, Y., Currim, F., Dong, F., Dantas, E., Saboia, L. A. (2016). SMARTBUS: A web application for smart urban mobility and transportation. In *Proceedings of AW4City 2016 Workshop, in Conjunction with the WWW2016 ACM 25th World Wide Web International Conference*. April 11, 2016, Montreal, Canada.

Rawlings, J., Coker, P., Doak, J., & Burfoot, B. (2014). Do smart grids offer a new incentive for SME carbon reduction? *Sustainable Cities and Society, 10,* 245–250.

Sankarasubramaniam, Y., Akyildiz, I. F., & McLaughlin, S. W. (2003). Energy efficiency based packet size optimization in wireless sensor networks. In *Proceedings of the First IEEE International Workshop on the Sensor Network Protocols and Applications* (pp. 1–8). doi:10.1109/SNPA.2003.1203351

Seoul Metropolitan Government (SMG). (2010). *The 2030 Seoul Plan*. Retrieved August 2016 from http://english.seoul.go.kr/policy-information/urban-planning/urban-planning/1-2030-seoul-basic-urban-plan/

Shadbolt, N., O'Hara, K., Berners-Lee, T., Gibbins, N., Glaser, H., Hall, W., et al. (2012). Linked open government data: Lessons from data.gov.uk. *IEEE Intelligent Systems, 27*(3), 16–24.

Shwayri, S. T. (2013). A model Korean ubiquitous eco-city? The politics of making Songdo. *Journal of Urban Technology, 20*(1), 39–55.

Siemens. (2015). *Research project Seestadt Aspern*. Retrieved August 2016 from http://www.siemens.com/press/pool/de/events/2015/energymanagement/2015-11-euw/presentation-aspern-e.pdf

Simon, P. (2013). *Too big to ignore: The business case for big data* (p. 89). New Jersey, U.S.A: Wiley.

Smart Dubai. (2015a). *Smart Dubai introduction, strategy & progress report*. Retrieved March 2017 from https://www.itu.int/en/ITU-D/Regional-Presence/ArabStates/Documents/events/2015/SSC/S1-DrAishaBinBishr.pdf

Smart Dubai. (2015b). *A collaborative approach to smart city transformation*. Retrieved March 2017 from http://smartdubai.ae/whitepaper/Smart_Dubai_WhitePaper.pdf

Smart London Board. (2014). *Smart London Plan*. Retrieved August 2016 from http://www.london.gov.uk/sites/default/files/smart_london_plan.pdf

Snowflake Software. (2012). *Data harvesting: On-time, accurate and easy delivery of data*. Retrieved August 2016 from https://www.snowflakesoftware.com/2012/03/data-harvesting-on-time-accurate-and-easy-delivery-of-data/

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307–320.

Steemers, K. (2003). Energy and the city: Density, buildings and transport. *Energy and Buildings, 35,* 3–14.

Su, K., Li, J. and Fu, H. (2011). Smart City and the Applications. In the *Proceedings of the 2011 IEEE International Conference on Electronics, Communications and Control (ICECC)*, Zhejiang, China, pp. 1028-1031

Tanabe, M., van den Besselaar, P., & Ishida, T. (2002). *Digital cities II: Computational and sociological approaches*. Berlin Heidelberg: Springer.

Tene, O., & Polonetsky, J. (2013). Big data for all: Privacy and user control in the age of analytics. *Northwestern Journal of Technology and Intellectual Property, 11*(5), 239–274.

Tisne, M. (2014). *The business case for open data*. Retrieved August 2016 from http://blog.okfn.org/2014/06/23/the-business-case-for-open-data/

Tsolakis, N., & Anthopoulos, L. (2015). Ecocities: An integrated system dynamics framework and a concise research taxonomy. *Sustainable Cities and Society, 17,* 1–14.

U.C. Berkeley's Department of City and Regional Planning. (2012). *Smart cities Berkeley*. Retrieved August 2016 from https://smartcitiesberkeley.wordpress.com/2012/02/27/smart-economy/

United Nations (UN). (2015). *Transforming our world: The 2030 agenda for sustainable development*. Retrieved March 2017 from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

UN HABITAT. (2006). *City planning of Kyoto in partnership with residents, developers and city authorities*. Retrieved March 2017 from http://www.iclei.org/details/article/the-master-plan-of-kyoto-shaped-by-its-citizens.html

Van Bastelaer, B. (1998). Digital cities and transferability of results. In *Proceedings of the 4th EDC conference on digital cities* (pp. 61–70), Salzburg.

van den Besselaar, P., & Koizumi, S. (2003). *Digital cities III. Information technologies for social capital: Cross-cultural perspectives*. Berlin Heidelberg: Springer.

Vienna City Administration. (2014). *Smart city Wien: Framework strategy overview*. Retrieved August 2016 from https://smartcity.wien.gv.at/site/files/2014/10/140924_KF_SCW_gesamt_ENG.pdf

Viteli, J. (2005). E-Tampere: Social engineering of the knowledge society. In T. J. van Weert (Ed.), *Education and the knowledge society: Information technology supporting human development* (pp. 35–45). New York: Springer.

Vojnovic, I. (2014). Urban sustainability: Research, politics, policy and practice. *Cities, 41,* S30–S44.

Watson, V. (2013). African urban fantasies: Dreams or nightmares? *Environment and Urbanization, 26*(1), 215–231. doi:10.1177/0956247813513705

Wettig, J. (2002). New developments in standardisation in the past 15 years—Product versus process related standards. *Safety Science, 40,* 51–56.

Widmann, H. (2012). *Smart city: Viennese expertise based on science and research*. Vienna: Schmid Verlag.

Witten, I., & Frank, E. (2005). *Data mining* (2nd ed.). Morgan Kaufmann.

Yigitcanlar, T., & Lee, S.H. (2014). Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax? In *Technological Forecasting & Social Change*, *89*, 100–114.

Yu, H. M.-T. (2012). *Designing software to shape open government policy*. Princeton University.

Zhang, Y., Chowdhury, P., Tornatore, M., & Mukherjee, B. (2010). Energy efficiency in telecom optical networks. *IEEE Communications Surveys & Tutorials, 12*(4), 441–458.

Zhang, L., & Zhao, S. X. (2009). City branding and the Olympic effect: A case study of Beijing. *Cities, 26,* 245–254.

Chapter 4
The Smart City Market

After reading this chapter, you will be able to answer the following questions:

– *Where does the source of smart city value lay?*
– *Which components synthesize the smart city market?*
– *What types of smart city business models exist?*
– *What is the optimal smart city business model?*
– *What does city branding mean in practice?*
– *Is smart city a market trick?*

4.1 The Smart City Value

A novel smart city market evolves radically and it is estimated to reach US $1 trillion by 2025 and exceed the size of all traditional business sectors (Amarnath 2010; Kohno et al. 2011). In 2016 alone, an amount of US $39.5 billion was projected to be spent in smart city technologies (CISCO 2014). Giles (2012) located the source of this money on embedded operational efficiency (Anthopoulos et al. 2016) (gained e.g., by the local government in its typical transactions and corresponding spending or by energy savings etc.) as well as on new entrepreneurship (e.g., new companies' registration in the digital economy as it is observed in Tampere and NYC or in green or creative industries). These money origins concern the primary value source for smart city, which attracts vendors to engage in this domain. Moreover, in terms of local growth, the installation of companies that have been attracted from other regions, allocates new capital in the city and generate new jobs.

However, added value comes from other sources too, according to the identified challenges that the smart city deals with: city's adaptation to climate change improves urban behavior against extreme environmental phenomena and in this respect, enhances residents' safety feelings. Moreover, city real-time monitoring

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_4

with cyber-physical integration and IoT enhances officials' responses against traffic and various types of accidents and crimes, which also increase residents' satisfaction from city performance. Additionally, data collection and analytics enable the municipality to enhance its planning (e.g., develop new cycle paths or pedestrian areas in crowdie places) or to control sprawl. Furthermore, typical process automation (e.g., waste collection and process that was documented in New Songdo or house remote control) simplify routine procedures and improve residents' satisfaction. Finally, citizen engagement in policy making increase their beliefs in government's accountability and transparency.

However, the smart city evolution is led by public investments, which have been secured either directly from the municipal budget or by national resources. The analysis of the examined cases in Chap. 3 validate this claim, while Anthopoulos and Fitsilis (2014a, b) demonstrated that 34 and 100 examined smart cities respectively, mainly concern public projects, with only 2 cases representing private investments and about 10 concerning Public Private Partnerships (PPPs).

This phenomenon questions the reluctance of the private sector to place own funding on smart cities. CISCO (2012) justified this phenomenon due to the city complexities (multiple parties, stakeholders, and processes) and to different interests. Another potential reason for this reluctance is described by Giles (2012), who claimed that the value of the smart city market is still under development and enterprises prefer to secure their involvement with government support, standardization and business models.

4.2 Types of Companies in Smart City

This subsection aims to provide a brief but sufficient snapshot of the alternative business sectors that participate in smart city. It follows the findings from Chap. 3, with regard to the technologies that synthesize a smart city and provides with representative references to vendors, while it does not aim to advertise any company or exclude someone on purpose. In this regard, smart city is an interdisciplinary domain, where all business sectors participate and provide several use-cases with alternative solutions.

Many companies have already entered and dominate the smart city market (IDC 2015), like IBM (2010), Alcatel-Lucent (2012), Schneider (2014), Hitachi (Yoshikawa et al. 2012; Kohno et al. 2011), Huawei (2014), Siemens (2014), Oracle (2016), Microsoft (2014), Fujitsu (Hisatsugu 2014), SAP (2014), CISCO (2014), Hewlett Packard (2012), LG (2016) etc.

However, the above vendors represent mainly the ICT and energy sectors, while Chap. 3 introduced several more sectors being engaged in the smart city era, like the construction industry (e.g., Gale International (2009); POSCO (2015) and Kohn Pedersen Fox (KPF) architects etc.); engineering [e.g., Siemens (2015)];

telecommunication networks (e.g., MerGroup (2014) etc.); smart water (e.g., Kamstrup[1] and Master Meter[2] etc.); smart lighting (e.g., SunFor,[3] Philips[4] and General Electric[5] etc.); smart healthcare solutions (e.g., NEC[6] and MySmartSimulations[7] etc.); waste management (e.g., Samsung clever rubbish process site in Songdo, and SmartStreets smart bin solutions in London etc.); bike (e.g., GridBikes,[8] CycleHop[9] and NextBike[10] etc.) and car sharing (e.g., Car2Go[11] and ZipCar[12] etc.); environmental sensing (e.g., Environmental Sensors Co.[13] and TSI[14] etc.); smartcards[15]; data[16] and business analytics (e.g., SAS[17]); as well as software development (e.g., several start-up companies that produce smart services and mobile Apps) and geospatial solutions (e.g., ESRI[18] and Leica[19] etc.) and so forth.

Due to the complexity of the broad solutions' context that the above sectors provide to the smart city and to the uncertainties that their interrelation brings, companies try to utilize standardization and several standards are being developed, as the previous chapter validated.

4.3 Smart City Business Models

A business model (Anthopoulos et al. 2016) describes the rationale of how an organization creates, delivers, and captures value (Turban 2002; Morris et al. 2006). According to Timmers (1998), a business model concerns "an architecture of the products, services and information flows". This definition recognizes actors, roles,

---

[1] https://www.kamstrup.com.

[2] https://www.mastermeter.com/en/index.html.

[3] http://sunfor.com/.

[4] http://www.lighting.philips.com/main/systems/connected-lighting/connected-lighting-for-smart-cities.html.

[5] https://www.ge.com/digital/industries/intelligent-environments.

[6] https://www.nec-enterprise.com/solutions/Smart-Healthcare-168.

[7] http://www.mysmarthealthcare.com/.

[8] http://gridbikes.com/.

[9] http://cyclehop.com/.

[10] http://www.nextbike.net/.

[11] https://www.car2go.com.

[12] http://www.zipcar.com/.

[13] http://www.environmentalsensors.com/.

[14] http://www.tsi.com/environmental-sensors/.

[15] http://www.smartcardalliance.org.

[16] http://datasmart.ash.harvard.edu/.

[17] http://www.sas.com/en_us/news/press-releases/2016/february/local-government-iot-analytics-smart-cities.html.

[18] http://www.esri.com/smart-communities.

[19] http://leica-geosystems.com/industries/reality-capture/digital-city.

the business value and its source. Alternative tools for business model composition and visualization exist, among which the most popular are the *business model matrix* (Walravens 2012) and the *business model canvas* (Osterwalder and Pigneur 2010). The *matrix* focuses on control and value parameters, while the *canvas* contains four components and focuses on value proposition (Bucherer and Uckelmann 2011):

- The *Infrastructure* component describes the key partners in value proposition, which perform key activities and require key resources to implement the value proposition.
- The *value proposition* specifies what is actually delivered to the customer.
- The *customer* component includes the customer segments addressed by the company, such as related channels and customer relationships.
- The *financial* component comprises the costs as well as the revenue sources and calculations.

Although there could be various value propositions, business models can be classified in five patterns according to (Osterwalder and Pigneur 2010):

- *Unbundling*, which is adopted by firms that perform all the three fundamentally different types of businesses: customer relationship; product innovation; and infrastructure businesses.
- The *long tail* according which a firm tries to sell less for more. This model can be addressed by the offering of a large range of products, each of which sells relatively infrequently.
- *Multi-sided platforms*, which bring together two or more distinct but interdependent groups of customers (e.g., a game console brings revenue to the producer both from individual sales and from game sales).
- *Free* that continuously benefits at least one substantial customer segment from a free-of-charge offer.
- *Open* that can be used by companies to create and capture value by systematically collaborating with outside partners.

Furthermore, business model innovation concerns the development of novel business models (Bucherer and Uckelmann 2011). With regard to the smart city, a quick look at the above vendors and the provided solutions show that several business models can be utilized, which depend on the value requestor (the project owner or the solution provider). In this respect, typical trade business models bring revenue to the seller (e.g., all the above vendors sell their products to cities), while service provision business models bring profit to the providers (e.g., telecommunication providers in a smart city).

Moreover, unique business models appear in this domain like the “city-in-a-box” developed under the case of new Songdo, where a prototype of a city-from-scratch is used by all the primary contractors (constructors and telecommunication providers) for contracting new city development. Moreover, cities aim to increase their national or international roles—with attracting residents, visitors and businesses or even being operated as transit centers for goods and people-, and in this regard, the Hub and Spoke Business Model is being adopted by city owners (Amarnath 2010).

Due to this broad context of smart city business models, a literature analysis was performed in July 2015 (Anthopoulos et al. 2016) on SCOPUS® and Google Scholar® sources with the use of the combination of keywords “smart city” and “business model”. The results are presented on (Table 4.1), on which screening was followed and several irrelevant articles were left out from further study.

	Source	Results	Articles after screening
1	SCOPUS®	27	6
2	Google Scholar®	892	20

The remainder articles were utilized to provide with answers the following questions with regard to smart city:

– Q1: who produces value?
– Q2: what type of value can be produced?
– Q3: who are the value beneficiaries?
– Q4: which are the corresponding cost and revenue structures?
– Q5: who controls the value network and the overall system design?

Figure 4.1 demonstrates an indicative business model canvas for a value proposition from a car-sharing service, in attempt to clarify each the above questions. Answering Q1 is simple from the smart city owner’s perspective, when 6 different business model types exist (Amarnath 2010; Biet 2014):

1. Build Own Operate (BOO) (e.g., in NYC)
2. Build Operate Transfer (BOT) (all PPP cases)
3. Open Business Model (OBM) (e.g., Geneva MAN)
4. Build Operate Manage (BOM) (e.g., the city-in-a-box CISCO’s solution in Songdo)
5. Build Operate Comply (BOC) (e.g., the Vienna’s stakeholders)
6. Municipal Owned Deployment (MOD) (e.g., in Trikala, Greece).

According to the above business models, value creators in smart cities could be (Anthopoulos et al. 2016) *integrators* between individual solutions (e.g., smart water-pipes with GIS integration); *Network Service Providers* that offer collaborative networks, data analytics and business solutions; *Pure-Play Product Vendors* that provide “hard assets” like smart utilities, IoT and smart meters; and *Managed Service Providers* that offer support services like monitoring, on-site consulting etc.

Beyond the above, novel businesses can utilize openness in smart city (e.g., open data, open apps, open innovation assets) to create and deliver smart services (e.g., new apps). Moreover, smart hard infrastructure enables new innovative strategies for crowdsourcing and learn from open innovation (Casprini et al. 2014). This infrastructure enables various use cases regarding all smart city dimensions—e.g., parking e-payments, waste management services etc.-, which offer novel business

Table 4.1 Extended business model matrix (Walravens 2013)

Control parameters				Value parameters			
Value network parameters		**Functional architecture parameters**		**Financial model parameters**		**Value configuration parameters**	
Combination of assets		**Modularity**		**Cost (sharing) model**		**Positioning**	
Concentrated	Distributed	Modular	Integrated	Concentrated	Distributed	Complement	Substitute
Vertical Integration		**Distribution of intelligence**		**Revenue model**		**User involvement**	
Integrated	Disintegrated	Centralized	Distributed	Direct	Indirect	High	Low
Customer Ownership		**Interoperability**		**Revenue sharing model**		**Intended value**	
Direct	Intermediated	Yes	No	Yes	No	Price/Quality	Lock-in
Public Design Parameters							
Governance Parameters				**Public value parameters**			
Good governance		Technology Governance		Return of Public Investment		Public Value Creation	
Policy Goals							
Governance Parameters				**Public value parameters**			
Harmonising existing policy goals and regulation **Accountability and Trust**		Inclusive versus Exclusive Open versus Closed data		Expectations on financial returns Multiplier Effects		Public value justification Market failure motivation	
Stakeholder management		Public data ownership		Public partnership		Public value creation	
Organizational							
Governance Parameters				**Public value parameters**			
Choices in (public) stakeholder involvement		Definition of conditions under which and with whom data is shared		PPP etc.		Yes/No Public value testing	

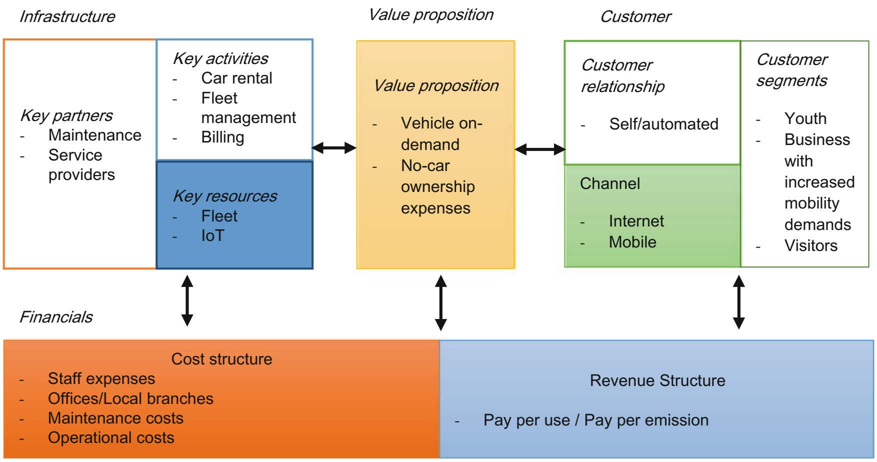


Fig. 4.1 Indicative business model canvas for a smart city car-sharing value proposition

opportunities (Dlodlo et al. 2013). Moreover, IoT extends the above models, since smart infrastructure is being installed by various vendors independently and business model innovation can be developed (Silva and Maló 2014).

With regard to Q2, the produced value considers the value that each individual creates within the smart city. Moreover, from the own point of view, value concerns that smart city addresses its mission (e.g., enhance living, adapt to climate change, grow local economy etc.). This value is being created via smart service delivery and alternative value propositions can be provided (Table 4.2) (Mulligan and Olsson 2013).

Table 4.2 Types of produced value (Mulligan and Olson 2013)

Produced value category	Example	Technical impact
Environmental enhancement	IoT, smart grids, recycling, waste management etc.	New devices, new processes
Economic growth	Incubators, new business registration, start-ups etc.	Open data, analytics, creativity
Cost efficiency	Government agencies integration	Cloud computing, open data, networked agencies
Safety and emergency	City monitoring and event response	IoT, new data sources, analytics, open data
Quality of life	Citizen feedback collection, crowd-sensing	Data analytics
Connected citizens	Apps	Privacy, data analytics, open data
New business models	IoT based business models	Privacy, data analytics, open data

Value beneficiaries (Q3) are both smart service providers (supply side) and service consumers (demand side). Cost and revenue (Q4) depend on the specific value proposition and vary according to the type of business that is being developed. Finally, the value network's control (Q5) or in other words the smart assets' control may be held by several actors like the municipality in case it installs and owns the infrastructure; individual partners in case of OBM, BOM, BOC; or a coalition of partners in case of PPPs (BOT).

The example of (Fig. 4.1) shows that the value proposition of a car-sharing service provider comes from the offer a vehicle-on-demand, while it frees customer from ownership a vehicle and corresponding expenses. The service provider is the value proposer, while indicative customer groups access this online service and gain this value, paying the provider either per-use (e.g., days/hours etc.) or per-emission (e.g., driven distance). On the other hand, service provider's expenses come from the appropriate resources' and operational costs, which provide enough saving due to several automated processes that come up from technology (e.g., customer self-service, distant vehicle's condition monitoring etc.).

Similarly, the example of (Fig. 4.2) depicts the municipality's value structure from smart city ownership with regard to internal operational cost savings. Smart infrastructure enables VoIP calls between municipal agencies, check-in and check-out real-time monitoring and paperless transactions, which are the primary saving sources. Moreover, someone could propose buildings' sensing and automation (e.g., smart lighting, heating management etc.) that would contribute with additional savings. Beyond the business model canvas, a business model matrix or its extended version (Table 4.1) can be utilized to for value origins' determination, accompanied by the value network's controllers.

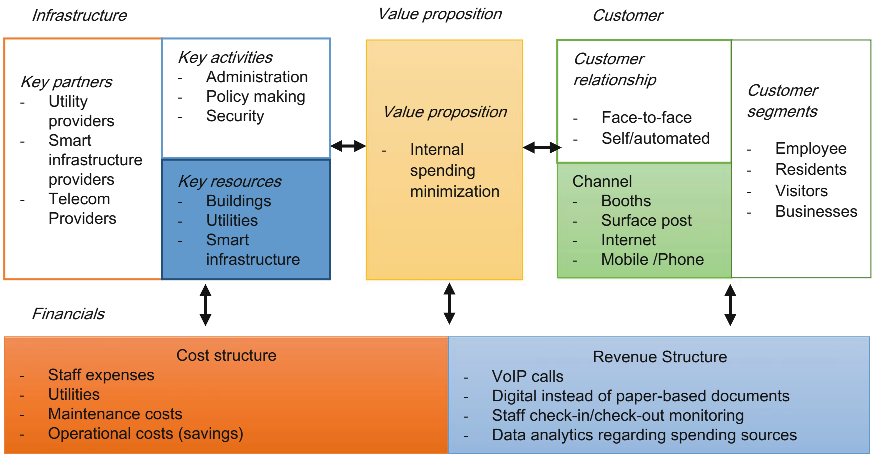


Fig. 4.2 Indicative business model canvas for smart city owner (municipality) value proposition

Taking into account all the above information and literature findings the identified business models for smart cities can be classified in the following 6 groups (Table 4.3):

- *E1. Internet of things*: business models that utilize IoT.
- *E2. Network ownership*: smart infrastructure and network ownership.
- *E3. Web-based*: smart government value propositions (Table 4.4).
- *E4. E-commerce*: e-business and e-marketing models (Table 4.5).
- *E5. Business model innovation* that utilize smart infrastructure (e.g., crowdsourcing etc.).
- *E6. Ownership business models*: concern smart infrastructure ownership or even the entire smart city ownership.

Tables 4.3 and 4.4 illustrate how web-based (Kuk and Janssen 2011) and e-commerce (Turban 2002) business models respectively, match the previously presented patterns. Traditional business models exist even in web/online cities, where the case's owner is an information or web service provider (Anthopoulos et al. 2016).

All the above classes with their sub-elements return value to stakeholders in terms of local government's internal efficiency (web-based models); revenue (network providers); city attractiveness (e-commerce models); or standardization (value integrators). According to the literature evidence, the official reports, the narrative visits and the interviews with the officials, the investigated cases that were presented in Chap. 3 have defined alternative value propositions, while they have adopted specific business models from the project-owner perspective (Table 4.5). These findings demonstrate that open access network is the favorite one. This is quite unexpected since it underlines facility's commercialization, where other smart city business models that are being proposed in literature, do not appear to be followed in practice.

Moreover, Anthopoulos et al. (2016) went further and they utilized the interviews under a decision-making process in an attempt to define the optimal business model for a smart city, from the project owner's perspective.

Decision making is a process that concerns the optimal—among alternatives—choice, with the application of particular criteria (Yates 1990). Various terms deal with decision making and concern, the *decider* who is the person that selects a solution to a specific problem; alternative is a solution to the problem; *alternatives' set* is the group of available solutions, which have to be homogenous and remain unchanged during the process lifecycle; implication is an indirect result of the decision making; *preference* is the prioritization of a solution compared to its alternatives; preference scale is the classification of the alternatives according to various criteria; *decider's preference profile* concerns the characteristics of a decider—e.g., experiences, values etc.—, which affect his decision; *criterion* is a parameter, the value of which influences the decision making process; *criterion scale* is the set of values that a criterion can take; *monotony* describes a criterion, the values of which, when they increase or decrease, the corresponding preference

Table 4.3 Different types of smart city business models (Anthopoulos et al. 2016)

	Business model	Description	References
E1. Internet of Things			
(1)	Direct information payments	Digital goods' direct selling	Gao et al. (2015), Casprini et al. (2014), Jin et al. (2014), Kitchin (2014), Perera et al. (2014), Silva and Maló (2014), Dlodlo et al. (2013), Elmangoush et al. (2013), Valja et al. (2013), Vilajosana et al. (2013), Bucherer and Uckelmann (2011)
(2)	Advertisements	Digital advertisements	
(3)	Fremium	Smart service provision, which combine free-of-charge delivery (Free) with charges on extras (Premium)	
(4)	Pay-per-use/Pay-As-You-Use/Pay-As-You-Go	Application of different charge levels, according to content or service use	
(5)	Discovery services	Information discovery and intelligence services	
(6)	Decision making add-ons	Software add-ons on existing applications	
(7)	Electronic Data Interchange (EDI)	High level data access contracts	
(8)	Service-Level-Agreements	High quality of service availability contracts	
(9)	Alert services	Services that offer pre-analyzed information alerts	
(10)	Co-creation	Information co-creation and co-deployment services	
(11)	Data-mining	Data-mining and data-warehousing services	
(12)	Product-as-a-Service	Services that enable product payment per-use instead of ownership	
(13)	Information Service Provider	Services that offer pre-analyzed information	
(14)	End-user involvement	Crowd-sensing services	
(15)	Right-time Business Analysis and Decision making	Real-time product monitoring services	
(16)	Open data product and service creation	Open data utilization for new products or services	

(continued)

Table 4.3 (continued)

	Business model	Description	References
E2. Network ownership models			
(17)	Private	Network installation and operation by a single private provider	Anthopoulos and Fitsilis (2013, 2014b), Alcatel-Lucent Market and Consumer Insight team (2012)
(18)	Exclusive	Network installation with public procurement processes by a private contractor	
(19)	Managed	Constructor assigns private network management to a single operator. Various providers can rent the network and offer communication services	
(20)	Open	Various constructors can install and operate their private networks with procurement processes	
(21)	Private	A single constructor can install and operate its private network	
E3. Web-based			
(22)	Content Provider	Static and/or dynamic digital content provision services (i.e. for a product or an organization etc.)	Ferro and Osella (2013), Molinari (2012), Deakin (2011), Kuk and Janssen (2011), Janssen et al. (2008)
(23)	Direct-to-Customer	Direct service provision (information, communications or transactions)	
(24)	Value-net-integrators	Information collection, process and deployment services, which focus on particular customer groups (e.g., businesses)	
(25)	Full Service Provider (FSP)	Organizations provide full services (collaborating with various segments or other organizations) directly or via allies owning customer relationships	
(26)	Infrastructure service provider	Infrastructure rental or Product-as-a-Service (PaaS)	
(27)	Market Creation	Demand and supply matching services (e.g., volunteer network structuring)	
(28)	Collaboration	Tools provision for civic-engagement, decision making, crowd-sourcing etc.	
(29)	Virtual Communities	Groups of common interests are structured and share content	
(30)	Open data-related	Premium/Freemium/Open-source like/Infrastructural Razor & Blades/Demand-Oriented Platform/Supply-Oriented Platform/Free as Branded Advertising/White-Label Development	

(continued)

Table 4.3 (continued)

	Business model	Description	References
E4. E-commerce			
(31)	Value chain integration	Productivity, efficiency and accessibility increase	Ferro and Osella (2013), Walravens (2012), Yovanof and Hazapis (2009), Turban (2002)
(32)	Social networks	Utilize social networks for promotion and selling	
(33)	Direct online marketing	Online advertisements, newsletters and campaigns	
(34)	Digital malls	Online marketplaces	
(35)	Information agents	Information service providers	
(36)	Affiliate marketing	Online advertisements	
(37)	Tendering	Online spaces with tendering options	
(38)	Reverse auctioning	Online spaces with reverse auctioning options	
(39)	Group purchasing	Virtual communities with common purchase interests	
(40)	Customization	Services for custom product or service design and deployment	
E5. Business model innovation			Nam and Pardo (2011)
(41)	Create business opportunities	Smart facility installation for business attraction; open data and App launch; open infrastructure; business incubators	Ferro and Osella (2013), Vilajosana et al. (2013), Lindgren et al. (2010)
(42)	Know-how transfer to other cities	A city operates as a smart city consultant to others	Anthopoulos and Fitsilis (2013, 2014b)
(43)	Develop high speed networks and smart grids for energy management	Telecommunications networks' and smart-grid installation	Amarnath (2010), Lee et al. (2010), Kohno et al. (2011), Mulligan and Olsson (2013)
(44)	Develop new ideas for the urban space	Urban space enhancement services	Johnson et al. (2013), Ballesteros et al. (2015)
(45)	City as a product	New city or district development	Alusi et al. (2011), Kohno et al. (2011)
(46)	Climate change management	Products for climate change monitoring	Anthopoulos and Fitsilis (2014b)

(continued)

Table 4.3 (continued)

	Business model	Description	References
(47)	Develop standards for smart city solutions	Standards' development and deployment	Anthopoulos and Fitsilis (2014b)
(48)	Develop cloud services and open data	Smart cloud service and open data provision	Walravens (2012, 2015), Kitchin (2014), Ferro and Osella (2013)
(49)	Hub and Spoke Business Model	Gain from capital's, people's and goods' flow	Amarnath (2010)
(50)	Engage mayors internationally to preserve climate change and establish urban resilience.	City alliances (e.g., ICLEI, European City Innovation Network etc.) that investigate common interests and organizations that consulate city governments	Anthopoulos and Fitsilis (2014b)
(51)	Facility or resource sharing	Bike and car sharing models or Peer-2-Peer services	Cohen (2016)
(52)	Governance models	The cooperative governance model for sharing-economy startups (e.g., digital coin, digital wallets, e-payments etc.) or for organization forming (e.g., taxi collaboration under mobile Apps)	Cohen (2016)
E6. Ownership business models			
(53)	Build Own Operate (BOO)	The smart city planner independently builds the city infrastructure and delivers smart city services	Biet (2014), Amarnath (2010)
(54)	Build Operate Manage (BOM)	The smart city planner appoints a trusted partner to build the city infrastructure and provide smart city services for a specific period	
(55)	Build-operate-transfer (BOT)	The smart city planner appoints a trusted partner to develop the city infrastructure and services (PPP)	
(56)	Build-operate-comply (BOC)	The smart city planner provides a more open environment, creating a platform for development and allowing private entities to build services atop, as long as they agree to certain regulations and funding levels	
(57)	Municipal-owned-deployment (MOD)	The city takes responsibility for the entire project	
(58)	Open Business Model (OBM)	The smart city planner assigns to contractors to install smart infrastructure and/or to deploy smart services	
(59)	Workplace structure models	Anyone from Organic, Centralised, Coordinated, Multiple Hub and Spoke (Dandelion) and Holistic (Honeycomb) can be adopted by smart city owner in order to control new business development	Cohen (2016)

Table 4.4 E-Commerce business models

Id	e-Commerce Business Model(s)	Business model pattern
1.	1. Social Networks	Free
2.	1. Membership 2. Social Networks 3. Affiliate marketing	Open
3.	1. Value chain integration	Unbundling
4.	1. Affiliate marketing 2. Value chain integration 3. Membership	Unbundling
5.	1. Value chain integration 2. Social networks 3. Direct online marketing 4. Digital malls 5. Information agents 6. Affiliate marketing 7. Tendering 8. Reverse auctioning 9. Group purchasing 10. Customization	Unbundling
6.	1. Value chain integration	Unbundling
7.	1. Customization 2. Social networks	Unbundling

changes respectively; and *criterion weight* is a value that describes the importance of the criterion to the decider (Yates 1990).

The decision-making process combines decider's personal estimations with the estimated implications of each choice and does not necessarily result to the optimal solution. Instead, it returns the choice that best satisfies the decider, compared to the alternatives. In the *Multi-Criteria Decision Making* (*MCDM*) process the alternatives are classified according to more than one criteria (Yates 1990) and consists of the following steps:

- *1st step—decision purpose definition*: alternatives' definition and classification.
- *2nd step—criteria definition*: returns monotonous, complete and redundant criteria.
- *3rd step—selection model definition*: criteria are grouped in classes and structure an assessment model.
- *4th step—decision making*: decider uses the model and concludes on the alternative.

For the purposes of their work, Anthopoulos et al. (2016) selected the *ELECTRE* (Elimination Et Shoix Traduisant La Realite) multi-criteria decision making process (Rogers et al. 2010; Pang et al. 2011). This method was introduced in 1965 and has been updated several times since then. The most famous version is the third one, named *ELECTRE TRI* (Mousseau et al. 2000). The reasons that made the authors

Table 4.5 Identified business models in the investigated cases

	Case	Proposed value	Business model	Pattern
1.	Trikala	Smart city know-how transfer to other cities	Direct sale	Unbundling
2.	Tampere	New jobs and local economic growth	Open network with expert free-lancers	Open
3.	Geneva	Develop high speed networks and smart grids for energy management	Open access network (rent to operator)	Open
4.	Seoul	Create a better and happy city of citizens	Open access network (rent to operator)	Open
5.	New Songdo	City as a product	Full service provider	Unbundling
6.	Vienna	Standardize for all stakeholders' projects	Value-net-integrators	Open
7.	London	Climate change management	Full service provider	Unbundling
8.	Washington DC	Establish local and regional development with land utilization, open data release	Information service provider	Unbundling
9.	NYC	Develop cloud services and enhance data economy	Information service provider	Unbundling
10	Hong Kong	Utilize intelligence and local ICT industry for economic growth, social engagement and government service enhancement	Open access network (rent to operator)	Open
11	Melbourne	Develop new ideas for the urban space	Full service provider	N/A

prefer these methods against other decision making processes concern their broad applicability on every type of decision problems; their ability to define alternatives and selection criteria in detail; and the increased accuracy that their combination secures.

The decision purpose of Anthopoulos et al. (2016) defined the alternatives to be the six business model groups (E1–E6) and their sub-elements (Table 4.3) and the selection criteria to be the 5 (from totally 6) smart city dimensions (*I1: Economy, I2: Governance, I3: People, I5: Living* and *I6: Environment*), which have been utilized by United Nations Habitat for city key-performance indicators' definition. Another index (I4) was defined and concerned city's hard infrastructure, in order to account the city type (new or existing) as well as the smart city type according to their classification (Anthopoulos and Fitsilis 2013). All these indexes were qualitative and their values range between 1 and 10.

The decision-making methodology was executed in 2 rounds with the same participants that were the interviewees of the examined cases, as well as with a representative from U.N. Habitat, a representative from the ITU and an official from Zurich smart city. First, the ELECTRE I methodology returned as the optimal business model group the *E6—Smart City Ownership model group*, which was not surprised since the deciders followed the project owner's perspective. Then, the ELECTRE TRI methodology used the same criteria and the same of group of deciders in order to evaluate the optimal sub-element of the E6 class (A1: BOO; A2: BOM; A3: BOT; A4: BOC; A5: MOD; A6: OBM). In both rounds the most important criterion was rated to be the Economy smart city's dimension, which was also a normal outcome since a business model reflects—among others—the value origins and corresponding financials. This second round rated A6 (OBM) to be a good choice, while A5 (MOD) concerns an intermediate one that requires deeper analysis. The OBM was located in literature findings and in this respect it did not concern a surprise. On the contrary, the MOD was an unexpected outcome due to its complexity and the sustainability questions that this choice rises, but it can be justified by the fact that today, smart city development is based mainly on public funding (Anthopoulos et al. 2016).

4.4 City Branding Versus Smart City?

Chapter 2 demonstrated that there's an increasing city competition in terms of attracting new residents (nice place for living), visitors (desirable tourist destination) and businesses (e.g., headquarters of international companies) (Anthopoulos and Fitsilis 2013) or in other words for mobile resources, markets, opportunities and attention (Zhang and Zhao 2009) or resources and incentives from various funds at national level, in order to invest into infrastructure, as well as cultural, economic and other development projects (Lulić et al. 2016).

This phenomenon was justified in Chap. 3, where almost all the official websites of the investigated cases classify their information and services to these 3 "customer segments", while there's an increasing argument that smart city is a marketing outcome that generates a smart utopia. This section will try to clarify whether smart city aims to enhance city's "soft power"[20] in the international arena or it's only a "vehicle" for city promotion.

The trend of promoting a city has been labeled as "city for sale" (Zavattaro 2013), according which in their attempts to enhance their position in this international "race", cities have adopted marketing and branding techniques, while they utilize technology for public diplomacy and for increasing their "soft power". Moreover, it is called "place branding" or "city branding" and concerns a challenge for cities which already have strong image, as well as for those who still need to build it. Brands are the basis of long-term survival for every company in the market, including the cities (Lulić et al. 2016). Brands represent a set of tangible and

[20]Soft power is a concept that aims to describe the ability to attract and co-opt rather than by coercion (hard power), using force or giving money as a means of persuasion. Soft power is the ability to shape the preferences of others through appeal and attraction (Nye 2005).

intangible values of the product for its users, but in terms of cities, regions and states they act as a certain label, which summarizes all of our expectations, thoughts, beliefs, knowledge, feelings and associations that we already have in our minds about a specific state, a city or a region (Lulić et al. 2016).

Such a branding example that has been questioned as “marketing hoax” is New Songdo, which has been labeled as “tomorrow city”. Several advertisements, web pages, social media (e.g., YouTube® etc.) have broadcasted this “slogan” that this smart city case signalizes: developing a one-of-its-kind smart, sustainable and future city. However, the learning by experience method that was followed with a narrative walk and the interview with the officials showed that this marketing effort generates huge expectations—for at least visitors like me—, which were not met during my visit. Similarly, (Table 4.6) demonstrates how the investigated cases selected a brand name and broadcast it with the use of technology.

The above evidence show that city branding represents a brand name that cities select to express themselves, which concerns the definition and communication of place’s unique attributes, such as *culture, language, architecture, cuisine, heritage,*

Table 4.6 The investigated cases’ city branding (August 2016)

	Case	Official website	Brand (August 2016)
1.	Trikala	http://www.trikalacity.gr http://www.e-trikala.gr	Trikala: The city of music Trikala: a smart & resilient city
2.	Tampere	https://www.e-tampere.fi/english/ https://yritystampere.fi/en/smart/smart-city	Tampere: All Bright!
3.	Geneva	http://www.ville-geneve.ch/	Geneva—Ville Durable
4.	Seoul	http://english.seoul.go.kr/	I. Seoul. U: between people, there is Seoul
5.	New Songdo	http://songdoibd.com/ http://english.incheon.go.kr/index.do https://www.youtube.com/watch?v=fHO_zkHPTaI	New Songdo: Tomorrow City
6.	Vienna	https://www.wien.gv.at/english/ https://smartcity.wien.gv.at/site/en/projekte/	Vienna: Now or Never
7.	London	http://www.cityoflondon.gov.uk	
8.	Washington DC	http://dc.gov/	
9.	NYC	http://www.nyc.gov	One New York: a strong and just city
10.	Hong Kong	http://www.gov.hk/ http://www.brandhk.gov.hk/	Hong Kong: Asia’s World City
11.	Melbourne	http://www.melbourne.vic.gov.au/	

and more. By synthesizing those elements to shape brand identity and influence brand image concerns how those receiving messages (organizational communications) understand the branding campaign (Zavattaro 2012, 2014). Moreover, place branding is a "*network of associations in the consumer's mind based on the visual, verbal, and behavio*[*u*]*ral expression of a place, which is embodied through the aims, communication, values, and the general culture of the place's stakeholders and the overall place design*" (Sevin 2014) or in other words "*a clear definition of brand identity and its positioning in the minds of consumers*" (Lulić et al. 2016).

Place branding is a relatively new academic area that borrows theories and practices from other disciplines including—but are not limited to—urban planning, corporate branding, marketing, public relations, sociology, psychology, management, and organizational communication. Zavattaro (2014) uses interview findings to ground place marketing's origins and realizes that cities utilize a mix of branding, marketing, and public relations in their attempts to attract (marketing) and retain (public relations) consumers, ideally to engender brand loyalty and equity, like businesses do. In this regard, place branding goes beyond simple logo and slogan definition and becomes an integral part of local governments' efforts to foster democratic legitimacy. Moreover, place branding uses a combination of market models of governance, communication style (press agentry; public information; one or 2-way asymmetrical[21]; and one or 2-way symmetrical) (Grunig and Hunt 1984; Murphy 1991; Falconi et al. 2014) and language used, and six promotional tactics (branding, media relations, in-house publications, use of outside people or organizations as public relation (PR) surrogates, aesthetic and affective appeal, and the built environment) (Zavattaro 2013).

According to these studies, the primary source for place branding appears to be (Fig. 4.3) *residents*, since they establish the local historical and cultural foundation; following by *business-based forms of governance*, which demonstrate that local government has adopted market-based forms as a means to reduce what was labeled as excessive, big government and to consider citizens as customers; *communication models* (e.g., press agents, public information and two-way symmetric or asymmetric models etc.) that the local government uses in its attempt to express its ethics, values, policies, and practices of service delivery; *selling tactics* that the city officials implement for place promotion (branding, media relations, in-house publications etc.); and *Baudrillard's Phases of the Image* in terms of how the local government defines its philosophy, imagery and symbolism.

With the utilization of the above sources a city can follow potentially several phases in developing its own branding. According to Zavattaro (2014) these phases are four (Fig. 4.4) and are parts of a corresponding framework. Each of the first 3

[21]Symmetric approach is defined as having "*effects that a neutral observer would describe as benefitting both organization and publics. Organizations practicing two-way symmetric public relations use bargaining, negotiating, and strategies of conflict resolution to bring about symbiotic changes in the ideas, attitudes, and behaviors of both the organization and the publics*" (Grunig and Hunt 1984; Murphy 1991).

Fig. 4.3 Place branding origins

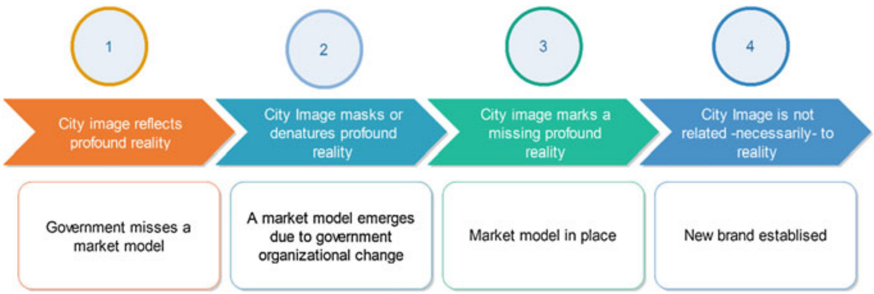


Fig. 4.4 City branding development steps (Zavattaro 2014)

steps can result to a potential stop if the local government wishes to and in this respect this framework utilizes communication styles and selling tactics. Indicatively, when the city image masks the absence of a profound reality (step 3), the local administration adopts four or five selling tactics.

Place branding's performance can be measured and in this respect Sevin (2014) compares 3 of the prominent corresponding indexes:

1. Anholt-GfK Roper City Brands Index (ACBI): it contains six separate measures for the characteristics of cities.

    a. *Presence*: city's contribution in science, culture and governance.
    b. *Place*: people's perception regarding city physical aspects and attractiveness.
    c. *Prerequisites*: beliefs regarding city's basics (e.g., schools, hospitals etc.).
    d. *People*: whether residents are perceived as warm and welcoming.
    e. *Pulse*: existence of interesting things to do during free time.
    f. *Potential*: economic and educational opportunities in the city.

2. FutureBrand Country Brand Index (FCBI): country branding is the attempt to capture a country's narrative and assets for internal and external audiences.
3. East–West Nation Brand Perception Index (NBPI): quantifies quantify international perceptions of nations.

The main outcome of the above index presentation concerns the understanding of the impulse that city branding has on people and in this respect the identification of the local forces that affect peoples' perception, which have to be respected by city branding efforts. Thus, a city needs to adopt the right strategies in order to brand itself successfully.

Successful city branding depends greatly on the identification of distinctive and defining characteristics (like the above) possessed by the city in question (Zhang and Zhao 2009). In this regard, a key challenge of city branding is the definition of city's identity and core values in a manner that is widely acceptable, easily marketable, presentable and open to experience in a daily manner. However, product branding strategies are not likely appropriate in the context of a city where ownership, stakeholder involvement with competitive interests and branding development are more complex (Zhang and Zhao 2009). Thus, indicative strategies can involve tourism or other city activities (e.g., economics, studies etc.). The paradigm of Beijing for instance (Zhang and Zhao 2009) utilized tourism and 2008 Olympic games and attempted to enhance the city's picture in terms of a "friendly global city", with enduring civilization and embracing modernity. Corresponding evaluation of this branding strategy measured peoples' perception regarding city's internationalization, cultural significance and livability and results highlighted Beijing's cultural significance, which means that city's problems remained regardless a successful branding.

In the beginning of this section, 3 supplementary works (Anthopoulos and Fitsilis 2013) and (Zhang and Zhao 2009; Lulić et al. 2016), show that smart city and city branding have a common purpose: to enhance city's potential in the race that has been grounded between cities at both international and national levels and concerns the attraction of residents, visitors and businesses. In this respect, it is important to clarify what is the common ground between smart city and city

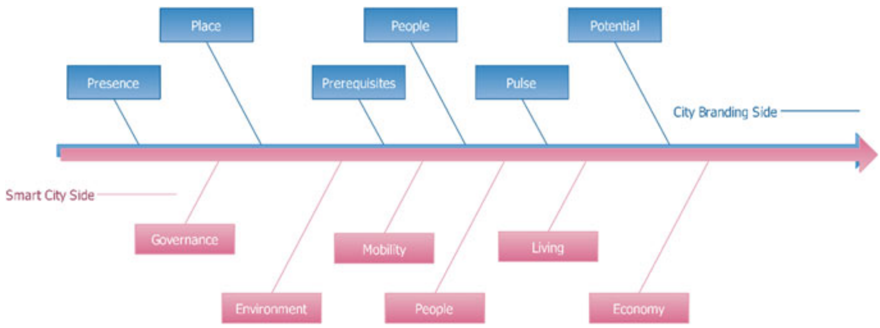


Fig. 4.5 An interrelation between city branding and smart city indexes

branding. A comparison between the indexes that measure both these terms (Fig. 4.5) depicts a connection between the pieces as follows:

1. Presence: city's contribution is enhanced with smart governance tools;
2. Place: city's physical features are supported with smart environment systems;
3. Prerequisites: city's hard facilities concern among others mobility;
4. People: residents' behavior depends a lot on their "intelligence";
5. Pulse: interesting things concern living style (e.g., opera, music etc.);
6. Potential: economic opportunities raise with smart economy.

This interconnection is mainly based in the fact that smart city initiatives improve local potential and as such the origins for city branding. However, the figure works in the opposite direction too, when branding plays the role of a mask of a missing city's profound and in this respect, branding could demonstrate an overestimated smart city case (e.g., in case of New Songdo personal experience). In such case, the smart city potential is utilized for marketing purposes in an attempt to attract the appropriate interest.

Since according to Graham (2002) two parallel cities co-exist (*the external*, which can, at least superficially, be encapsulated in one or two signature buildings or landmarks and *the internal*, the subjective image created in our minds, according to each individual's experiences and priorities), then the above interconnection has a clear sense: a smart city can be figured with tangible representative features too, like a usual city does (e.g., some hard infrastructure or some smart services and Apps), which can develop alternative subjective images according to an individual's understandings or beliefs. In this respect, city branding can creative an "illusionary" smart city image and vice versa, meaning that smart city can—but not necessarily—play the role of a marketing trick for increasing a city's image.

No evidence exist that smart city plays a vital role for city branding until recently. For instance, the study from Lulić et al. (2016) that demonstrates the sources of city branding for London and Vienna that were discussed in Chap. 3

Table 4.7 Branding sources (Lulić et al. 2016)

London	Vienna
Big Ben	Advent
London eye	Castles
Rain	Architecture
Queen	History
Thames	Culture
Kingdom	Beauty
Phone booth	Mozart
Red Color	Danube
Red Bus	Excursion
Culture	Handball
Fashion	City fair
Parks	
Sightseeing	
Amusement	

(Table 4.7) do not refer to smart infrastructure or services. However, they refer to facilities (physical environment) and living styles that have not been affected by technology yet, neither have been addressed by the corresponding smart city initiatives and planning.

4.5 Conclusions

This chapter has a multi-purpose dimension. First it made clear that smart city's value deal with the city's response against the identified challenges described in Chap. 2. Then, it attempted to explore the source of this value that can justify the growth and size of the corresponding market. In this regard, it identified various sources instead of unique, which mainly deal with city efficiency's empowerment and new job creation. In order to clarify how this value returns to its provider, it discussed about business models and corresponding theories; it illustrated indicative examples of business models that utilize value proposition both for an individual in the smart city ecosystem (a car-sharing example) and for the project owner (municipal's internal cost saving). Following this theoretical approach, several business models that deal with smart city have been located in literature and past findings from a decision-making process showed the optimal business model from the smart city owner perspective. Finally, it questioned whether the smart city value can generate an urban utopia, which is being broadcasted by city branding. In this respect, it explained the city branding context and identified a bi-directional interconnection between the origins of branding and smart city. This interrelation shows that the smart city can enhance a city's brand, while a city's brand can affect the development of a smart city too.

Revision Question 1:	what types of value does the smart city generate?
Revision Question 2:	which are the origins of smart city value?
Revision Question 3:	what types of companies structure the smart city market?
Revision Question 4:	mention 2 companies from different sectors that are being engaged in the smart city market and their products.
Revision Question 5:	define the business model term.
Revision Question 6:	design the business model canvas for a fiber-optic constructor in a smart city.
Revision Question 7:	list the business model classes for a smart city.
Revision Question 8:	what do brand and city branding stand for?
Revision Question 9:	which are the origins of city branding?
Revision Question 10:	list the phases of a city branding development.
Revision Question 11:	compare the Vienna experience and its branding.
Revision Question 12:	what is the relation between city branding and smart city?
Revision Question 13:	how can smart city affect city branding?

References

Alcatel-Lucent Market and Consumer Insight team. (2012). *Getting smart about smart cities understanding the market opportunity in the cities of tomorrow*. Retrieved August 2016 from http://www.tmcnet.com/tmc/whitepapers/documents/whitepapers/2013/7943-alcatel-lucent-getting-smart-smart-cities-recommendations-smart.pdf

Alusi, A., Eccles, R. G., Edmondson, A. C., & Zuzul, T. (2011). *Sustainable cities: Oxymoron or the Shape of the Future?* Retrieved August 2016, from http://environment.harvard.edu/sites/default/files/Oxymoron%20White%20Paper%20042211.pdf

Amarnath, A. (2010). *City as a customer strategy: Growth opportunities from the cities of tomorrow*. Retrieved August 2016, from https://tapahtumat.tekes.fi/uploads/e5695265/Amarnath_Archana-4306.pdf

Anthopoulos, L., & Fitsilis, P. (2013). Using classification and roadmapping techniques for smart city viability's realization. *Electronic Journal of e-Government, 11*(1), 326–336.

Anthopoulos, L., & Fitsilis, P. (2014a). Smart cities and their roles in city competition: A classification. *International Journal of Electronic Government Research (IJEGR), 10*(1), 67–81.

Anthopoulos, L., & Fitsilis, P. (2014b). Exploring architectural and organizational features in smart cities. In *The Proceedings of the 16th International Conference on Advanced Communications Technology* (*ICACT2014*), IEEE.

Anthopoulos, L., Fitsilis, P., & Ziozias, C. (2016). What is the source of smart city value? A business model analysis. *International Journal of Electronic Government Research (IJEGR), 12*(2), 55–75.

Ballesteros, L-G-M., Alvarez, O. and Markendahl, J. (2015). Quality of Experience (QoE)-based service differentiation in the smart cities context: Business analysis. In *The Proceedings of the International Conference on City Sciences* (*ICCS*)*: New architectures, infrastructures and services for future cities,* Shanghai.

Biet, N. (2014). *Internet of Things: Overview of the market*. Retrieved August 2016, from http://www.thefaktory.com/wp-content/uploads/2015/01/IoT-market-overview-Final.pdf

Bucherer, E., & Uckelmann, D. (2011). Business models for the Internet of Things. In Uckelmann et al. (Eds.), *Architecting the Internet of Things*. Heidelberg, Dordrecht, London, New York: Springer.

Casprini, E., Di Minin, A., & Piccaluga, A. (2014). Business model innovation and open innovation in SMEs: The case of open territorial lab. In Casprini, E. (Ed.), *Business model innovation: Drivers, processes and capabilities* (pp. 63–91) (Ph.D. thesis). Scuola Superiore Sant'Anna.

CISCO. (2012). *Smart city framework: A systematic process for enabling smart + connected communities*. Retrieved August 2016, from http://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/motm/Smart-City-Framework.pdf

CISCO. (2014). *The city of the future: Smart and connected* [Online]. Retrieved August 2016, from http://www.cisco.com/web/tomorrow-starts-here/connectedcities/preview.html

Cohen (2016). *Making sense of the many business models in the sharing economy* [Online]. Retrieved August 2016, from http://www.fastcoexist.com/3058203/makingsenseofthemanybusinessmodelsinthesharingeconomy

Deakin, M. (2011). Intelligent cities as smart providers: CoPs as organizations for developing integrated models of eGovernment Services. *Innovation: The European Journal of Social Science Research, 25*(2), 115–135.

Dlodlo, N., Montsi, L., Mvelase, P., & Krause, C. (2013). Use cases and related business models for smart cities infrastructures. In *The Proceedings of the 5th International Conference on Adaptive Science and Technology* (*ICAST 2013*), Pretoria.

Elmangoush, A., Al-Hezmi, A., & Magedanz, T. (2013). Towards standard M2 M APIs for Cloud-based TelcoService platforms. In *The Proceedings of the 11th International Conference on Advances in Mobile Computing & Multimedia*, Vienna, Austria.

Falconi, T.M., Grunig, J.E., Zugaro, E.G., & Duarte, J. (2014). *Global stakeholder relationships governance: An infrastructure*. New York, U.S.A.: Palgrave MacMillan.

Ferro, E., & Osella, M. (2013). Eight business model archetypes for PSI re-use. *In The Proceedings of the Open Data on the Web workshop*. Retrieved August 2016, from https://www.w3.org/2013/04/odw/odw13_submission_27.pdf

Gale International. (2009). *Gale international presskit*. Retrieved August 2016, from http://www.galeintl.com/wp-content/uploads/Gale%20International%20PressKit.pdf

Gao, J., Lei, L., & Yu, S. (2015). Big data sensing and service: A tutorial. In *The Proceedings of the IEEE First International Conference on Big Data Computing Service and Applications*, Oxford, UK (pp. 79–88).

Giles, S. (2012). *One smart city business model is illusory*. Retrieved August 2016, from http://www.smartcitiesineurope.com/2012/09/one-smart-city-business-model-is-illusory/

Graham, B. (2002). Heritage as knowledge: Capital or culture? *Urban Studies, 39*(5–6), 1003–1017.

Hewlett Packard. (2012). *Empowering* "*Smart Cities*". Retrieved August 2016, from http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA3-9190ENW.pdf

Grunig, J.E., & Hunt, T. (1984). *Managing Public Relations*. Austin, Texas, U.S.A.: Holt, Rinehart & Winston.

Hisatsugu, T. (2014). Fujitsu's approach to smart cities. *Fujitsu*, *Science and Technology Journal*, *50*(2), 3–10. Retrieved August 2016, from http://www.fujitsu.com/downloads/MAG/vol50-2/paper01.pdf

Huawei. (2014). *Brilliant life powered by smart city*. Retrieved August 2016, from http://www1.huawei.com/en/about-huawei/publications/communicate/hw-079367.htm

IBM Institute for Business Value. (2010). *How smart is your city? Helping cities measure progress*. Retrieved August 2016, from http://www-05.ibm.com/cz/gbs/study/pdf/GBE03359USEN.PDF

IDC. (2015). *IDC MarketScape: Worldwide smart city business analytics software 2015 Vendor assessment*. Retrieved August 2016, from https://www.sas.com/content/dam/SAS/en_us/doc/analystreport/idc-smart-city-business-analytics-software-108005.pdf

Janssen, M., Kuk, G., & Wagenaar, R. W. (2008). A survey of web-based business models for e-Government in Netherlands. *Government Information Quarterly, 25*(2), 202–220.

Jin, J., Gubbi, J., Marusic, S., & Palaniswami, M. (2014). An information framework for creating a smart city through Internet of Things. *Internet of Things Journal, 1*(2), 112–121.

Johnson, P., Iacob, M.E., Välja, M., van Sinderen, M., Magnusson, C., & Ladhe, T. (2013). Business model risk analysis: Predicting the probability of business network profitability. In M. van Sinderen et al. (Eds.), *Enterprise interoperability lecture notes in business information processing*, *Vol. 144* (pp. 118–130).

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal, 79,* 1–14.

Kohno, M., Masuyama, Y., Kato, N., & Tobe, A. (2011). *Hitachi's smart city solutions for new era of urban development*. Retrieved August 2016, from http://www.hitachi.com/rev/pdf/2011/r2011_02_101.pdf

Kuk, G., & Janssen, M. (2011). The business models and information architectures of smart cities. *Journal of Urban Technology, 18*(2), 39–52.

Lee, J., Jung, D.-K, & Lee Y.-W (2010). Smart grid solutions, services, and business models focused on Telco. In *The Proceedings of Network Operations and Management Symposium Workshops* (*NOMS Wksps*), Osaka (pp. 323–326).

LG. (2016). *Smart green city powered by smart green platform* [Online]. Retrieved August 2016, from http://city.lgcns.com/Contents/EN/Solutions/OverviewCity.aspx

Lindgren, P., Taran, Y., & Boer, H. (2010). From single firm to network-based business model innovation. *International Journal of Entrepreneurship and Innovation Management, 12*(2), 122–138.

Lulić, L., Rocco, S., & Bartulović, K. (2016). Identity and branding of EU cities—Investigating attitudes of Croatian students. In *The Proceedings of the 14th International Scientific Conference on Economic and Social Development*, Belgrade, Serbia.

MerGroup. (2014). *Enabling smart cities by delivering the fiber infrastructure edge*. Retrieved August 2016, from http://www.mer-group.com/wp-content/uploads/2014/06/smart-city.pdf

Microsoft. (2014). *Microsoft citynext: What's next for your city?* [Online]. Retrieved August 2016, from https://enterprise.microsoft.com/en-us/industries/citynext/#fbid=9v7zlu-xXH9

Molinari, F. (2012). Innovative business models for smart cities: Overview of recent trends. In *The Proceedings of the European Conference on e-Government, ECEG 2012*, Barcelona, Spain.

Morris, M., Schindehutte, M., Richardson, J., & Allen, J. (2006). Is the business model a useful strategic concept? Conceptual, theoretical, and empirical insights. *Journal of Small Business Strategy, 17,* 27–50.

Mousseau, V., Slowinski, R., & Zielniewicz, P. (2000). A user-oriented implementation of the ELECTRE-TRI method integrating preference elicitation support. *Computers & Operations Research*, *27*, 757–777.

Mulligan, C. E. A., & Olsson, M. (2013). Architectural implications of smart city business models: An evolutionary perspective. *IEEE Communications Magazine, 51*(6), 80–85.

Murphy, P. (1991). The limits of symmetry: A game theory approach to symmetric and asymmetric public relations. *Public Relations Research Annual* [1042–1408], 115–131.

Nam, T., & Pardo, T. A. (2011). Smart city as Urban innovation: Focusing on management, policy, and context. *The Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance (ICEGOV2011)* (pp. 185–194). Estonia: Tallinn.

Nye, J. S. (2005). *Soft power: The means to success in world politics*. New York, U.S.A.: Public Affairs.

Oracle. (2016). *Oracle's smart city platform solution*. Retrieved August 2016, from http://www.oracle.com/us/industries/public-sector/national-local-government/city-platform/index.html

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Hoboken, New Jersey: John Wiley & Sons Inc.
Pang, J., Zhang, G., & Chen, G. (2011). ELECTRE I Decision model of reliability design scheme for computer numerical control machine. *Journal of Software, 6*(5), 894–900.
Perera, C., Zaslavsky, A., Christen, P., & Georgakopoulos, D. (2014). Sensing as a service model for smart cities supported by Internet of Things. *Transactions on Emerging Telecom munications Technologies, 25*(1), 81–93.
POSCO. (2015). *POSCO E&C Brochure*. Retrieved August 2016, from http://www.poscoenc.com/eng/pr/brochure.asp
Rogers, M. G., Bruen, M., & Maystre, L.-Y. (2010). *Electre and decision support: Methods and applications in engineering and infrastructure investment*. Bosts/Dordrecht/London: Kluwer Academic Publishers.
SAP. (2014). *Urban matters: Better cities, better lives* [Online]. Retrieved August 2016, from http://global.sap.com/demos/richmedia/videos/sap-urban-matters-better-cities-better-lives-12-ov-us.epx
Schneider. (2014). *We make smart cities a reality* [Online]. Retrieved August 2016, from http://www2.schneider-electric.com/sites/corporate/en/solutions/sustainable_solutions/smart-cities.page
Sevin, H. E. (2014). Understanding cities through city brands: City branding as a social and semantic network. *Cities, 38,* 47–56.
Siemens. (2014). *Transforming cities for the better through sustainable technology*. [Online]. Retrieved August 2016, from http://w3.usa.siemens.com/topics/us/en/sustainable-cities/Pages/home.aspx
Siemens. (2015). *Research project seestadt aspern*. Retrieved August 2016, from http://www.siemens.com/press/pool/de/events/2015/energymanagement/2015-11-euw/presentation-aspern-e.pdf
Silva, E. M., & Maló, P. (2014). IoT testbed business model. *Advances in Internet of Things, 4*(4), 1–8.
Timmers, P. (1998). Business models for electronic markets. *Journal of Electronic Markets, 8,* 3–8. doi:10.1080/10196789800000016.
Turban, E. (2002). *Electronic commerce: A managerial perspective*. London, UK: Prentice Hall.
Valja, M., Osterlind, M., Iacob, M.-E., van Sinderen, M., & Johnson, P. (2013). Modeling and prediction of monetary and non-monetary business values. *The Proceedings of the 17th IEEE International Enterprise Distributed Object Computing Conference (EDOC)* (pp. 153–158). BC: Vancouver.
Vilajosana, I., Llosa, J., Martinez, B., Domingo-Prieto, M., Angles, A., & Vilajosana, X. (2013). Bootstrapping smart cities through a self-sustainable model based on big data flows. *Communications Magazine, 51*(6), 128–134.
Walravens, N. (2012). Mobile business and the smart city: Developing a business model framework to include public design parameters for mobile city services. *Journal of Theoretical and Applied Electronic Commerce Research, 7*(3), 121–135.
Walravens (2013). The city as a service platform: A typology of city platform roles in mobile service provision. In *The Proceedings of the Nineteenth Americas Conference on Information Systems*, Chicago, Illinois.
Walravens, N. (2015). Qualitative indicators for smart city business models: The case of mobile services and applications. *Telecommunications Policy, 39*(3–4), 218–240.
Yates, J. F. (1990). *Judgment and decision making*. Englewood Cliffs, NJ, US: Prentice-Hall Inc.
Yoshikawa, Y., Sato, A., Hirasawa, S., Takahashi, M., & Yamamoto, M. (2012). Hitachi's vision of the smart city. *Hitachi Review, 61*(3), 111–118. Retrieved August 2016, from http://www.hitachi.com/rev/pdf/2012/r2012_03_101.pdf
Yovanof, G. S., & Hazapis, G. N. (2009). An architectural framework and enabling wireless technologies for digital cities & intelligent urban environments. *Wireless Personal Communications, 49*(3), 445–463.

Zavattaro, S. M. (2012). Place marketing and phases of the image: A conceptual framework. *Journal of Place Management and Development, 5*(3), 212–222.

Zavattaro, S. M. (2013). *Cities for sale: Municipalities as public relations and marketing firms*. New York, U.S.A: Suny Press.

Zavattaro, S. M. (2014). *Place marketing and phases of the image*. New York: U.S.A.: Palgrave McMillan.

Zhang, L., & Zhao, S. X. (2009). City branding and the Olympic effect: A case study of Beijing. *Cities, 26,* 245–254.

Chapter 5
Governing a Smart City

After reading this chapter, you will be able to answer the following questions:

– *What does governing a smart city mean?*
– *What is the view of smart city as a project?*
– *What is the view of smart city project as innovation?*
– *What does smart city organization mean?*
– *What types of smart city organization schemas exist?*
– *Can you define service automation, service simplification, deliberation* etc.*?*

5.1 Introduction

Governing a city means that city politicians and administrators try to keep the city operational in terms of utility service provision, law enforcement and political decisions' implementation. This term is also names as "urban governance", which is defined as "a political response to broader developments in society, such as globalization, internationalization, and privatization" (Van Marissing et al. 2006). This process should not aim to solve all the problems in the city but rather they should strengthen the capacity of urban systems to tackle a wide variety of problems and produce a wide range of public values (Landry 2006). Several city governance models can be located, which define the dimensions for smart city governance (Bolivar 2016).

On the other hand, *governing a smart city* or *smart city governance* could mean two contradictory things: (a) governing a city that has adopted smartness; (b) and managing the smart city, in terms of planning, implementation and operating the project/initiative. Chapters 2 and 3 of this book showed that the smart city project results to an environment, which integrates several entities ranging from people and stakeholders, to ICT and innovation, and to hard facilities and physical

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_5

Table 5.1 Perspectives on smart city governance (Meijer and Bolivar 2015)

Perspective on smart governance	Level of transformation focus	Focus
Government of a smart city	Low	Good administration, good policy
Smart decision-making	Medium-low	Innovative decision making processes
Smart government administration	Medium-high	Innovative organization and administration
Smart urban collaboration	High	Innovate governance networks

environment. This resulted urban environment has to be addressed both by project developers as well as by a smart government.

Governing a city (a) is being analyzed in detail in the following Chap. 6, as part of smart government. Such a process requires new forms of ICT-based human collaboration. City managers should realize that technology alone will not make a city smarter: building a smart city requires a political understanding of technology, a process approach to manage the emerging smart city and a focus on both economic gains and other public values (Meijer and Bolivar 2015). In Table 5.1 different perspectives for smart city governance are being depicted.

However, this chapter emphasizes on (b), which means that it investigates corresponding project requirements and managerial aspects. This selection was also based on the research agenda that has been defined by Ojo et al. (2016), who claim that smart city governance research topics concern *integrative urban planning, measurement, organization, policy and strategy, and standards and regulation*. From this point of view, the exploration of the smart cities' organization that was presented in Chap. 2 and the analysis of the smart city cases in Chap. 3 demonstrated several alternative smart city governance systems:

1. *The smart city owner is the city government* and in this respect, the city governs the smart city project. This is the most usual governance system, where the municipality or a corresponding state-owned-enterprise (SOE) plans and manages the smart city.
2. *The city partners with several stakeholders* (*PPP*) and in this respect a project coalition is generated to implement and manage the smart city. In this case, all the partners hold "shares" of the smart city project, while they have common interests with regard to its success.
3. *The city is a* manager, which standardizes, obliges and supervises a project portfolio that is being implemented by several stakeholders. In such cases, the city is interested in delivering its corresponding plan and it is responsible for the overall smart city monitoring and well-performance, while the stakeholders are individual project owners with competitive interests in the smart city.
4. *The city assigns the smart city completely to a private developer*. These cases mainly concern new city construction or district from scratch development, where one or several vendors implement and manage the smart city project.

The analyzed examples in this book highlight that cities are becoming smart in several ways that range from city's infrastructure upgrades, cyber-physical integration, ICT project development, innovation deployment, people knowledge enhancement, smart service delivery, evidence-based decision making etc. These facts determine that cities are becoming smart not only in terms of the way they can automate and optimize routine functions serving the city, but in ways that enable them to monitor, understand, analyze and plan the city to improve the efficiency, equity and quality of life for its citizens in real time (Batty et al. 2012).

Revision Question 1: what does governing a city mean?
Revision Question 2: list and explain the 4 smart city governance systems.

5.2 Smart City Development Framework

Regardless the project owner, the development of a smart city follows specific priorities and perspectives, which are analyzed and depicted on a corresponding framework. A framework is a decision methodology that enables actors (e.g., the public and the private sectors) to plan and implement something—in this case the smart city.

One of the most well-known development frameworks has been introduced by CISCO (Falconer and Mitchell 2012) and prioritizes city response with the use of ICT against increased population; economic growth; increased greenhouse-gas (GHG) emissions; and decreased budgets. Although the installation of the ICT solutions can integrate physical city infrastructures, it is a hard process due to city's operational, financial, regulation and planning complexities. In this respect, the introduced framework moves from (1) operational understanding; to (2) objectives' and stakeholder roles' definition; and to (3) the role of ICT within the physical assets clarification (Fig. 5.1) or in other words it moves to the following step 1:

5.2.1 *Framework Step 1: Collect Information Regarding the Smart City Objectives*

1. *Why is a Smart City initiative good for a city?*
   a. What is the gained value that justifies the initiative or innovation?

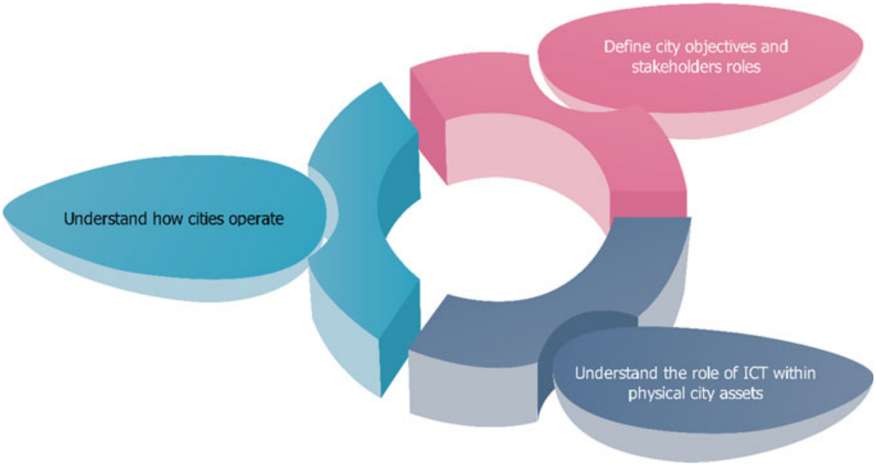


Fig. 5.1 Framework step 1—define the objectives

2. *What should we do?*
   a. Which solutions do we deploy?
   b. Which actions do we take?
   c. Which projects and components of the initiative are crucial?
3. *How do we implement solutions?*
   a. Which policies and business models must we have in place?

5.2.2 Framework Step 2: Collect Information About the City

A smart city framework provides with answers the following questions (Falconer and Mitchell 2012) that synthesize a clearer picture of the smart city (Fig. 5.2):

- Who operates the components of the city?
- Who controls and influences the behavior of the organizations that operate the components?
- How do city components interact with each other and with other stakeholders? Stakeholders play crucial role in smart city development and they must be defined and respected well (Fig. 5.4).
- Which business models are required for deploying smart solutions?
- What is the role of ICT?
- How are cities and initiatives measured?
- What is the role of government?

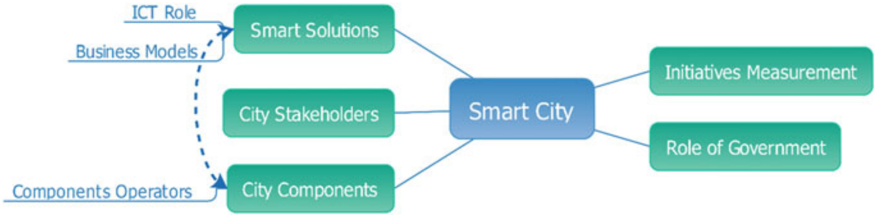


Fig. 5.2 CISCO framework step 2—understand the city

5.2.3 *Framework Step 3: Define Layers*

City leaders define actions or initiatives by their impact on stated city objectives. This is why the proposed Smart City Framework (Fig. 5.3) starts with city objectives as its base, against which all initiatives are then measured (Falconer and Mitchell 2012).

The above layers collect useful information with regard to the smart city initiative. *Layer 1* defines smart city objectives at a high level between city leaders and stakeholders. *Layer 2* assigns indicators to city objectives in an attempt to evaluate their potential and later their achievements. CISCO suggests a couple of indexes like the Global City Indicators Facility[1] (GCIF), the Mercer Quality of Living Survey,[2] and Green City Index[3] (Falconer and Mitchell 2012). However, they are not alone. Anthopoulos et al. (2016) discovered more than 15 smart city benchmarking systems, which measure smart city from different perspectives ranging from city capacity, to level of progress, local ICT size, value chain, city monitoring, policy and local sustainability. Index selection is up to project owner's willing and the corresponding objectives' definition. *Layer 3* collects details regarding city components/assets in the physical landscape, aggregating their location and industry sector. City assets were analyzed in Chap. 2 and can be organized according to Table 5.2. Finally, *Layer 4* determines how the smart solutions are being implemented, while it interconnects Layers 1 and 3. Much of the collected information concerns past implementations in other cities (case studies), while corresponding policies must be defined with the contribution of local stakeholders (Fig. 5.4).

The above framework results to a taxonomy/typology that enables cities to benchmark their capacity to implement smart city initiatives. Moreover, it identifies the city stakeholders' roles and a catalogue system of city content. These results

[1]www.cityindicators.org.

[2]www.mercer.com/surveys/quality-of-living-report.

[3]www.siemens.com/entry/cc/en/greencityindex.htm.

Fig. 5.3 CISCO framework layers

Table 5.2 Hierarchy of city components

Utilities	Transportation	Real estate	City services
Energy	Rail	Residential	Healthcare
Water	Road	Commercial	Education
Waste	Air	Retail/hotels	Safety/emergency
Telecommunications	Logistics	Public buildings	Public services

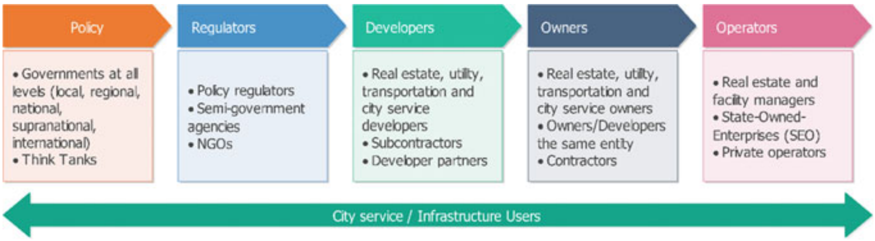


Fig. 5.4 CISCO framework's stakeholders (roles and responsibilities)

customize smart city blueprints; locates the ICT solutions and determines their development methodology; develops government policy guidelines for engaging the private sector in the initiative; enables city benchmarking and identifies gaps in the city environment. Smart city's implementation starts with the definition of a corresponding vision, which demands a close collaboration with the private sector, universities and NGOs for a successful implementation (Falconer and Mitchell 2012).

Additionally, the above implementation framework is not the only one that can be located. Hamza (2016) claims that developing countries require an alternative

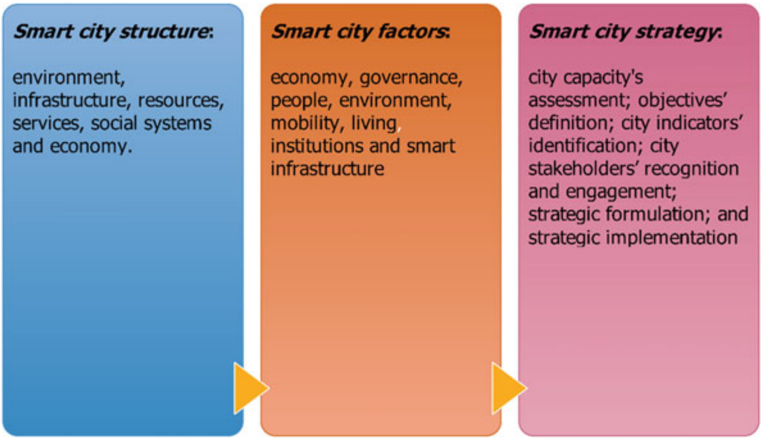


Fig. 5.5 The introduced framework for developing countries

framework, which has to (a) respect frameworks developed by technology companies such as CISCO and IBM from information technology practitioner's point of view; (b) understand the factors and characteristics of smart city developed by academics; and finally, (c) take the European Union standards for smart city and sustainable development recommendation by UN-Habitat. This process generated an alternative framework (Fig. 5.5), which consists of 3 layers:

- *Smart city structure*: environment, infrastructure, resources, services, social systems and economy.
- *Smart city factors*: Hamza (2016) adopts Giffinger et al. (2007) six smart city dimensions (economy, governance, people, environment, mobility and living) and extends them with institutions—that contribute to smart city management—and smart infrastructure—that integrates and enhances environmental protection.
- *Smart city strategy*: city capacity's assessment; objectives' definition; city indicators' identification; city stakeholders' recognition and engagement; strategic formulation; and strategic implementation (organized in 3 streams).

Finally, IBM (2009) introduces a framework that concerns the strategic planning for smart city development. This framework aims to identify the city's conditions and competencies (Fig. 5.6), which synthesize the baseline for further development.

Revision Question 1:	list and explain the process steps of a smart city development framework.
Revision Question 2:	which are the city stakeholder groups according to CISCO framework?

Fig. 5.6 IBM framework for smart city strategic planning

5.3 Smart City as Project

According to Project Management Institute (PMI 2013) a project is *a unique endeavor undertaken to create a unique product, service or result*. *Temporary* means that every project has a definite beginning and a definite end. *Unique* means that every project creates different (unique) deliverables, which are products, services or results. On the other hand, project management is *the application of knowledge, skills, tools and techniques to project activities that meet project requirements* (PMI 2013). Project management is accomplished through the integration of five (5) process groups: initiating; planning; executing; monitoring and controlling; and closing.

Since the smart city is a complex ecosystem that integrates hard and soft facilities as Chaps. 2 and 3 showed, it is clear that its implementation is based on the deployment of various projects, which address a set of predefined challenges. In this section, the smart city is considered to be a single project—instead of a project portfolio—in an attempt for its managerial requirements to be understood from a project management perspective (Anthopoulos et al. 2014). Such a project is **complex**—in terms of innovation and complexity (numerous components that have to be integrated)—**large-scale**—in terms of scope, duration and deliverables—and **ongoing**—since all smart cities are still under development—as it has been seen in Chap. 3.

A project management analysis is important since each smart city's social adoption is not secured in spite of project success in terms of scope, time, budget and quality, like it has happened in several cases (Table 5.3). Failures can occur due to inappropriate requirements' analysis (Ishida et al. 2009), which results to

Table 5.3 Cases that experienced different types of failure (Anthopoulos et al. 2014)

Case	Failure reasons
Vejle (Denmark)	Lack in cooperation with the local community's stakeholders
Wiltshire Telecottage Network	Clients' needs were misunderstood
Craigmillar Community Information Service	Citizens did not feel they contribute. Knowledge base updated to a digital city
Amsterdam De Digitale Stad	Continuous changes in the technological form. Failed to establish online communications and infrastructure accesses
Geneva-MAN	Managerial inefficiency, disagreements between stakeholders
City of Namur (Périclès)	Disagreements between stakeholders, large scale of e-services
Digital City of Trikala (e-Trikala)	Problems in project's integration, not of public interest, extensive maintenance costs
Chicago	Contractors introduced e-service charges
San Francisco	Financial viability plan was mistaken. Inefficient project analysis lead to network's extension, to alternative ICT solutions' selection and to budget's growth
Dongtan	Political dropdown
Marietta (Georgia), Ashland (Oregon), Lebanon (Ohio)	Underestimated budget, and ineffective cost planning

technologies that do not by themselves (a) bridge the digital divide, (b) support the local economic growth, and (c) guarantee digital city's economic viability (New Millennium Research Council 2005). The smart city of Trikala for instance, defined an overestimated smart service portfolio, with extensive maintenance costs, and which did not meet local community's expectations, as Chap. 3 documented. Failures, combined with the increasing skepticism of the smart city's overestimated potential or extremely futuristic so-called "smart utopia" (Allwinkle and Cruickshank 2011; Hollands 2008, 2015; Söderström et al. 2014; Watson 2013; Yigitcanlar and Lee 2014); and the inability of smart cities to meet their initially grounded objectives (Shwayri 2013; Yigitcanlar and Lee 2014), underline the importance of smart city project success. Successful cases require careful planning, that follow a combination of a bottom-up systems approach, a top-down service development and a data-centric approach (IEC 2014).

The project management perspective that will be analyzed follows the four (4) construction management generic project processes inspired by Winch (2009): (a) Defining the Project Mission; (b) Mobilizing the Resource Base; (c) Riding the Project Life Cycle; and (d) Leading the Project Coalition. In each process the 10 Project Management Institute Body of Knowledge (PMBOK) areas are considered and a smart city project-based approach is structured (PMI 2013):

1. *Project Integration Management*: integration includes characteristics of unification, consolidation, communication, and integrative actions that are crucial to controlled project execution through completion, successfully managing stakeholder expectations, and meeting requirements.
2. *Project Scope Management*: ensures that the project includes all the work required, and only the work required, to complete the project successfully.
3. *Project Time Management*: manages the timely completion of the project.
4. *Project Cost Management*: includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.
5. *Project Quality Management*: includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.
6. *Project Human Resource Management*: organizes, manages, and leads the project team.
7. *Project Communications Management*: ensures timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information.
8. *Project Risk Management*: conducts risk management planning, identification, analysis, response planning, and controlling risk on a project.
9. *Project Procurement Management*: includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team.
10. *Project Stakeholders Management*: identifies the people, groups, or organizations that could impact or be impacted by the project, analyzes stakeholder expectations and their impact on the project, and develops appropriate management strategies for effectively engaging stakeholders in project decisions and execution.

Finally, the outcomes from two smart city cases presented in Chap. 3 (a) Trikala and (b) New Songdo, will support understanding this smart city project-based approach.

5.3.1 Defining the Project Mission

The project's definition is the most critical process, where the stakeholders negotiate and determine project's scope, requirements, deliverables, duration and budget (Fig. 5.7). This particular process contains two separate activities: (i) understanding client's needs and (ii) stakeholders' management. These activities identify project's scope and organization; and emphasize on information flow and in this context, they achieve in PMBOK's project scope management and project communications management knowledge areas.

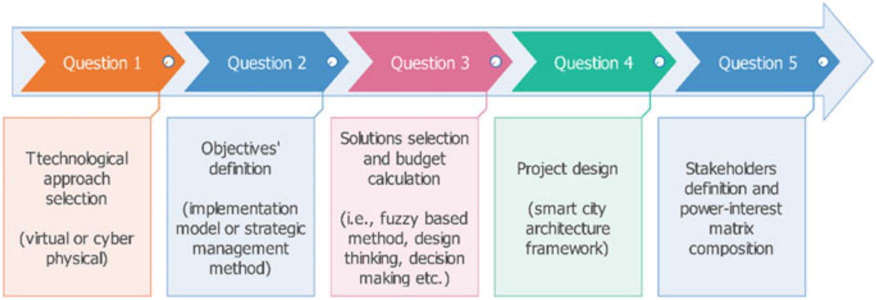


Fig. 5.7 Defining the project mission

As it was demonstrated in Chaps. 2 and 3, in most of the examined cases the client was the municipal or state government who envisioned the smart city. Successful cases concerned associations of the local government with universities and other stakeholders (e.g., Tampere, London and Vienna). In some cases, even partnerships and project coalitions with implementation vendors (PPPs) were structured to undertake the smart city mission (e.g., Songdo and Hong Kong). Then, the client (or the coalition) sets-up a project team that consists of representatives and managers, which supervises the project implementation on behalf of the client.

The first question that the client must answer concerns a generic (not a technological) approach that will be followed by the smart city: whether a virtual or cyber-physical environment will be structured. The selection of a virtual environment will limit project's scope to software and to information systems' implementation, with potential crowd-sourcing features. A cyber-physical environment on the other hand, extends its scope to construction activities (e.g. communications network installation, IoT etc.) in combination with ICT projects. In the Trikala case, a cyber-physical environment was developed, while the New Songdo adopted the same approach but with many embedded innovative characteristics (e.g., smart waste management).

The next question that the client answers concerns the project objectives' definition. This answer must respect a number of perspectives that face the particularities of the project ecosystem (location, community etc.). Anthopoulos and Tsoukalas (2006) introduced an implementation model for a digital city, which recognizes four axes of precedence for the local community's growth (economy, education and training, quality of life, and culture and tourism) and considers five perspectives for project's definition (social, technological, informational, ethical and financial). The implementation model can achieve in PMBOK's project integration management knowledge area, since it performs a detailed analysis of the local particularities, and it identifies the local segments (gap analysis) that smart city will close (Anthopoulos et al. 2014). An alternative approach to the above implementation model is the smart city's strategic management (Lysons and Farrington 2006). This approach requires the definition and management of the entire strategic life cycle: (a) analysis (David 2011); (b) synthesis [e.g., with the use Porter's (1996) five forces model, Marketing Mix of 7p's (Ivy 2008; Rafiq and Ahmed 1995) or the strategy map (Kaplan and Norton 1996)]; (c) implementation; (d) evaluation; and (e) review.

The third question concerns the solutions' selection for the smart city. The examined cases adopted many alternative solutions and deployed several smart services. This procedure is critical for project success since not all the available solutions are suitable for every city. Requirements engineering process can support the client in his decision making. Anthopoulos et al. (2011) for instance, simulated requirements engineering with a fuzzy based method in Trikala. This method identified suitability indices (extensibility, service availability, citizen satisfaction, and prerequisite systems) and the fuzzy based method returned the following results: smart government services score best in extensibility index; intelligent transportation in service availability; smart health and tourism in prerequisite systems; and smart education in citizen satisfaction (Anthopoulos et al. 2014). Alternative methods concern the execution of a decision-making process (e.g., with the contribution of the stakeholders) or the design thinking process that can be performed with the guidance of the project team and the contribution of the community and the stakeholders (e.g., in Melbourne). Then, the budget can be calculated according to solutions' selection (installation, operational and maintenance costs) and secured, and a viability model has to be composed (e.g., return-of-investment, value and income source definition etc.).

The fourth question concerns the project design, where the smart city architecture framework can support the detailed definition of the smart city (Chap. 2). Another critical question concerns project viability's evaluation. In this context, the project must meet the stakeholders' grounded expectations.

The final question collects information about the stakeholders. The stakeholders accompanied by their power/interest estimation on the project are necessary to be determined. The power/interest matrix and the stakeholders' network can provide the project team with valuable information to accurately and on-time communication and negotiation with all the key-players of the project. In Trikala case (Table 5.4) the stakeholders synthesized a peculiar environment. Although the bottom-up design method was followed (Anthopoulos and Tsoukalas 2006), the stakeholders' management process failed to control individual interests and to

Table 5.4 The power-interest matrix for the smart city of Trikala (Anthopoulos et al. 2014)

Low	Low	High
Power to influence	**A: Minimal effort** *Local banks, international community*	**B: Keep informed** *Political opposition, residents, environmentalists, schools, universities, the church*
High	**C: Keep satisfied** *International ICT market, standardization bodies, supranational organizations, national government*	**D: Key players** *Local government, regional government, local chamber, telecommunications providers, local and national ICT markets, local media*

engage the community, due to the miscommunication of the project's objectives, combined with the digital divide in the city, and with political oppositions. Today, the residents are not interested in using most of the smart services, except from the smart care ones that address the ageing part of the community.

5.3.2 Mobilizing the Resource Base

Under this process (Anthopoulos et al. 2014), the project owner selects the procurement system, which follows to award the contractors, he selects the payment methods and performs project integration. This particular process contains three individual activities (Fig. 5.8): (i) forming the project coalition; (ii) motivating the project coalition; and (iii) managing the dynamics of the supply chain. These activities achieve in PMBOK project integration management and project procurement management knowledge areas.

In case the owner is the local government (Anthopoulos et al. 2014), the procurement system respects the corresponding public tendering legal framework with regard to the contractors' selection. In case the owner is a coalition (e.g., a partnership of the local government, the local university, telecommunication vendors etc.), the procurement system selection depends on (a) who finances the project; (b) who owns the projects' deliverables; (c) which is the coalition form and the respective procurement legislation.

In the case of Trikala, the project owner is the Municipality. The same organization was responsible for project planning, contractors' awarding and project management from 2003 to 2006. Then, a state-owned-enterprise (e-Trikala S.A.) was founded with the participation of the Municipality (99%) and the local commercial chamber (1%) with a mission to undertake project management, operate the deliverables and secure project future. This organization failed in project integration management and several contractors were awarded, which implemented the individual projects for the smart city (e.g., a construction company installed a fiber-optic network, different ICT vendors launched corresponding smart services etc.) performing no integration amongst each other. The expenses were funded by the Greek and the European Information Society Framework Programs, and the

Fig. 5.8 Mobilize the resource base

project deliverables are owned by the Municipality. The project manager respected the Greek public procurement system together with the European tendering framework, which awarded the most competitive contractors. Contractual uncertainty was attempted to be minimized with the contribution of experts from national government (Greek Information Society Special Secretary) and with fixed price contracts, but managerial inefficiency led to quality divergences and to contracts with no maintenance support periods (Anthopoulos et al. 2014).

On the other hand, New Songdo (Lee and Oh 2008) was developed by the coalition of two private construction companies (POSCO and Gale International) and private investors (Morgan Stanley, ABN Amro, Bank of Nova Scotia, Woori Bank and Industrial Bank of Korea). This coalition was integrated in 2003 and founded a new private company (NSC), which became the project owner, and various other companies were engaged in an attempt to minimize project risks (innovation and uncertainties questioned project success). The LLC was one of these companies that joined the coalition later, which was the general contractor and responsible for completion assurance. Recognizing the unique characteristic of the Korean industry, the two construction companies—coalition members—decided to fund the equity of commercial projects by the proceeds from the residential unit sales, with the contribution of the investors. This decision strengthened internal mutual trust, which was critical for the partners, especially due to the fact that Gale had its chairs in the U.S.A. and was not aware of the national and local cultural environment. Procurement was mostly based on LLC's negotiations with the resource base of various suppliers. However, POSCO participated in some less-risky residential projects, and when it bid them it increased the construction costs, since it couldn't secure construction contracts with outside investors (Anthopoulos et al. 2014).

5.3.3 Riding the Project Life Cycle

This process (Fig. 5.9) is executed by the project manager in his attempt to control the project implementation in terms of budget, time, quality and risk. The following activities belong to this process: (i) minimization of client's surprise; (ii) problems' definition and solutions' generation; (iii) budget management; (iv) program management; (v) conformance or quality management; (vi) uncertainty and risk management; and (vii) information management. PMBOK project integration, scope, time, cost, quality, communications and risk management knowledge areas are combined by this process.

The first question that has to be answered concerns the identification of the project manager, of his efficiency to ride the project and of his power against the project organization. In the Trikala case, the project manager (e-Trikala S.A.) had enough authorization to procure and manage contracts with external suppliers, but with no particular managerial and technical efficiency. Moreover, e-Trikala S.A. was responsible for project operation and continuity on behalf of the owner

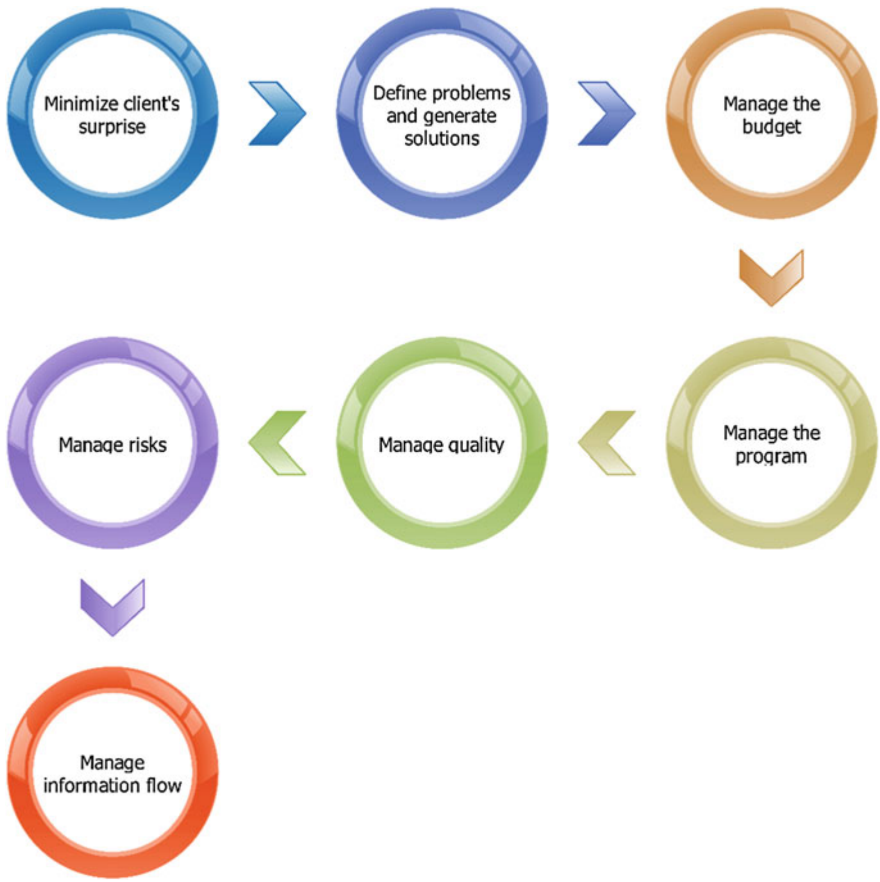


Fig. 5.9 Riding the project life cycle

(Municipality). Contractors beyond the city's boundaries were awarded without being oblige to enhance the efficiency of the owner that could secure deliverables' viability. Only the political opposition in the local council performed control on the project manager, who however had not enough capacity to intervene in managerial activities. On the other hand, things were different in New Songdo, due to project scale and to the coalition agreements, while the participating criteria concerned extreme capacity to fund and to implement mainly construction projects. The main managerial duties were undertaken by the LLC who was both a member of the coalition and a contractor (Anthopoulos et al. 2014).

The second question that has to be answered concerns the project management method that is followed, in order to secure time, scope, risk, cost, quality, and information flow. In Trikala, client surprises were small since all projects kept their initial objectives until their completion. However, today only a few smart services are being offered, since the project failed to gain social adoption. This failure was mainly based in the lack of stakeholder engagement during project planning and development. PRINCE2 methodology was followed by the project manager and contractual obligations were secured in terms of scope, time and cost. However, in some cases the deliverables failed to meet the initially grounded specifications (quality), due to the lack of ICT skills of the project manager to monitor the implementation. In New Songdo on the other hand, construction management methodologies were followed and a process of eight (8) development "silos" (Vision, Team Assemblage, Business Plan, Design, Permit, Financing, Marketing and Promotion, and Staffing) was adopted, since the project concerned mainly real estate activities. Only the investment risk was analyzed with a system of net present value calculations and more than three thousand Monte Carlo simulations (Lee and Oh 2008).

The third question that has to be answered is the identification of the project operations manager. Although the project life cycle concerns project maintenance, a smart city project is more complex in terms of uncertainty and technological risk. In Trikala, the project manager is the operations manager too, who has undertaken ICT relative duties (e.g. service provider, helpdesk, knowledge transfers etc.). The operations manager signed an agreement with the Municipality of a fee per service provision. The paradox however is that although the owner had been obliged by the Greek government to incorporate the projects' deliverables in the organization, he transferred them completely to the operations manager (Anthopoulos et al. 2014).

5.3.4 Leading the Project Coalition

This final process enables the project manager to perform human resource management, since he defines and controls the project organization, to which he is obliged to infuse the project mission. This process achieves in PMBOK project human resource management knowledge area (Anthopoulos et al. 2014).

Two questions have to be answered under this process and concern the project organization schema and the leadership style. Project organization in Trikala, concerned the foundation of a state-owned-enterprise (e-Trikala S.A.). This company was both the project manager on behalf of owner and a project management office (PMO) that stands between the client, the investors and the contractors. Each of the smart city individual projects followed its own project organization, which had to interoperate with e-Trikala S.A. The organization schema of e-Trikala S.A. is complex due to the lack in human resources and in technological skills, while duties overlapped during projects' implementation and operation (Fig. 5.10). It seems that e-Trikala S.A. follows both functional organization model and project-based organization model. However, a strong leadership with autocratic style was adopted in e-Trikala S.A., as a means to defend against project failures.

On the other hand, the project organization of the New Songdo city (Fig. 5.11) focused on successful implementation and on the investors' risk minimization. However, conflicts of interest occurred, since various partners wanted to both increase their earnings and to secure their funding. A less strong leadership with a

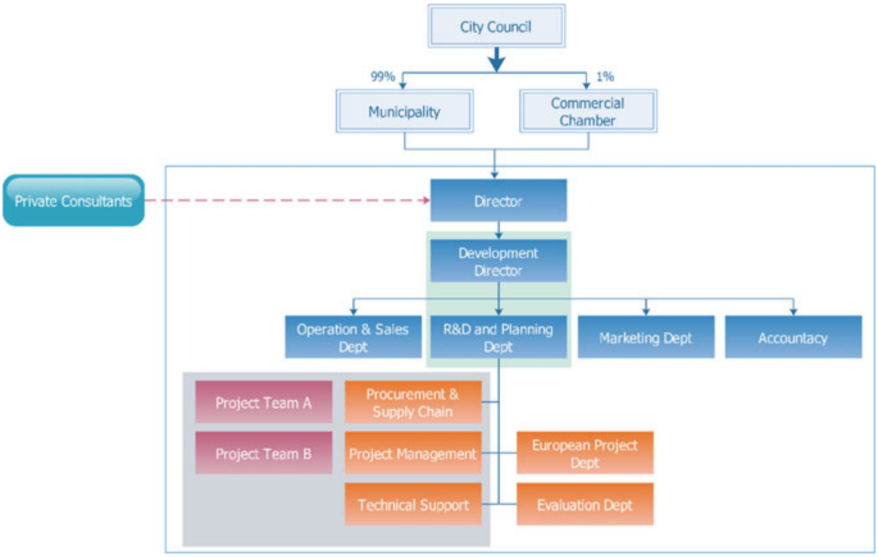


Fig. 5.10 e-Trikala Project Organization (Anthopoulos et al. 2014)

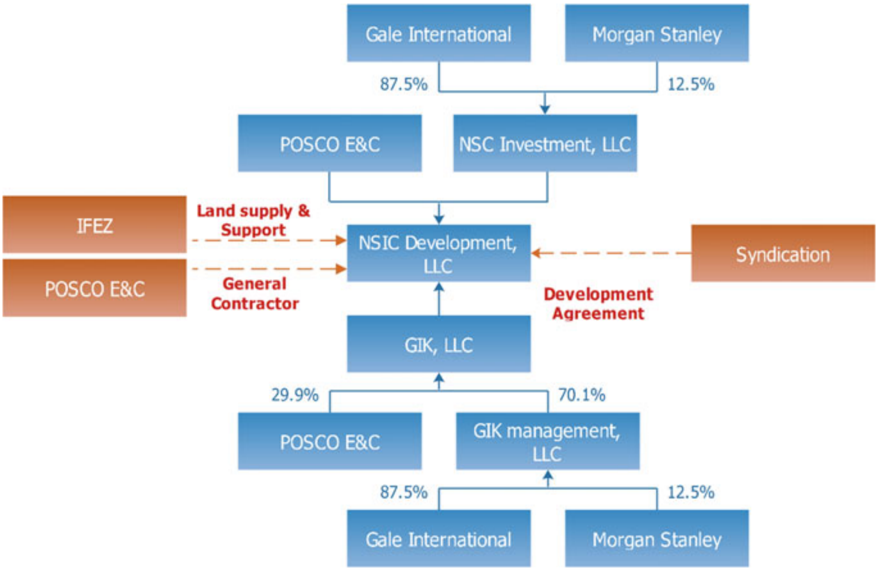


Fig. 5.11 New Songdo project organization (Lee and Oh 2008)

paternalistic style was adopted by the project coalition, since negotiation processes on project definition, constructability and contracting occurred (Anthopoulos et al. 2014).

5.3.5 A Project Management Model for Smart City Development

The above project management tasks generate a quite generic model for smart city development (Anthopoulos et al. 2014), especially when the smart city is considered to be a unique system. This model (Table 5.5) is a guide that respects all

Table 5.5 A generic project management model for smart cities

Question	Description/potential answer
Process 1: Defining the Project Mission	
Q1. Which generic (not a technological) approach will be followed my case?	*Virtual, mesh, innovative*
Q2. Which are the project objectives?	*Vision, axes of precedence, milestones*
Q3. Which are the most appropriate ICT solutions for my case?	*Requirements engineering for solution selection according to suitability criteria*
Q4. Which is the architecture of the project? (project design)	*n-tier, SOA, modular*
Q5. How viable is my project?	*Viability model definition*
Q6. Who are the stakeholders and what is their power/interest role in the project?	*Power/Interest matrix definition*
Process 2: Mobilizing the Resource Base	
Q7. Which is the procurement system that will be followed?	*Procurement system's identification according to (a) who finances the project; (b) who owns the projects' deliverables; (c) which is the coalition's form and the respective procurement legislation*
Process 3: Riding the Project Life Cycle	
Q8. Who is the project manager, and how efficient and effective he is to ride the project and the project organization?	*Project manager determination. Project organization's orientation*
Q9. Which is the project management method that will be followed?	*e.g. PRINCE2, construction management methods* etc.
Q10. Who is the operation manager of the project	*Operation manager's identification.*
Process 4: Leading the Project Coalition	
Q11. What schema is followed by the project organization?	*Functional/Project based/Integrated*
Q12. What leadership style is followed by the project manager?	*Autocratic, patermalistic*

PMBOK knowledge areas and contains the questions that a project manager has to answer before he undertakes the project. The above outcomes from the 2 cases can provide the project manager with indicative choices to avoid corresponding failures.

Revision Question 1:	which are the processes that synthesize a smart city project?
Revision Question 2:	which questions define the smart city project mission?
Revision Question 3:	which questions mobilize the resource base?
Revision Question 4:	which questions ride the project life cycle?
Revision Question 5:	which questions lead the project coalition?

5.4 Smart City as Innovation

5.4.1 Where Innovation Lies Within a City?

The definition of smart city in Chap. 2 showed clearly that it has to do with innovation—not necessarily but mainly—based on ICT and deployed within the urban space. The size of the emerging smart city market and the types of technology presented in Chaps. 2 and 3 validate that this innovation is the outcome of a technology-push force, which aims to deploy cutting-edge technology (e.g., IoT, crowdsourcing, new district development with cyber-physical integration etc.) within a city. On the other hand, smart city is the outcome of several innovative strategies (Gil-Garcia et al. 2014), which have been drafted by city governments across the globe, lead the smart city evolution and depict its potential by 2050 (Anthopoulos 2017).

Each of the smart solutions that is being deployed in a smart city can be considered an individual innovation, which solves a single problem (e.g., smart waste management attempts to effectively collect, recycle and process the increasing solid waste problem within cities etc.). Each individual smart solution is usually a product/service and radical, technological innovation and the outcome of open innovation, which is being developed either by the industry or as academia, while several research projects are also being deployed across the globe (Howells 2005; Maital and Seshadri 2007):

1. *OSLO classification*: most smart city solutions concern product/service innovation: novel smart infrastructure and/or smart services are being deployed within a smart city.
2. *Level of novelty*: most smart city solutions are novel; thus, they concern radical innovation. All of these solutions synthesize a novel system and in this respect, the smart city concerns a systemic innovation.

3. *Impact*: all the individual urban solutions concern technological innovation and remains to see whether the smart city—as a system—will result to a social innovation.
4. *Open/Close*: the smart city itself is the outcome of industrial and scientific development, which is not developed by a city and in this regard, it concerns open innovation. However, most of the individual innovative products are being developed within the industries—e.g., the energy or transportation sectors—and in this respect, they concern close innovations.

5.4.2 Measuring Innovation Capacity

The capacity of a city to innovate is questioned and it can be measured with alternative corresponding benchmarking tools (Anthopoulos et al. 2016). For instance, an interesting model introduced by Lombardi et al. (2012), examines the triple helix of a smart city—similarly to innovation development—and concerns a table with rows: University, Government, Civil Society, Industry and columns: smart governance, smart economy, smart people, living, environment (Table 5.6).

It is important to compare such a city innovation capacity measurement model with a model that is used to measure the innovation capacity of an enterprise (Table 5.7). This model focuses on business strategy, marketing, technological process, quality, logistics and human resources. For every of the six areas, there are six question, each with four possible answers. The answers are formulated so that they reflect the existing situation in the company (Maital and Seshadri 2007). A comparison between these two models generates important outcomes (Fig. 5.12).

This comparison shows potential connections between city and company's capacity measurement indexes:

1. **Governance—strategy and planning**: city is being governed by local government, which has to realize urban strategic formulation and implementation.
2. **Economy—marketing and technological process**: smart economy indexes that measure innovation performance, employment and entrepreneurship within the city (Giffinger et al. 2007) address marketing requirements (competition size, information flow and customer orientation) and technological process context (return of investment, competitiveness and production costs).
3. **Living—quality management**: smart living indexes (culture, health, safety, housing quality, education, touristic attractivity and social cohesion) (Giffinger et al. 2007) comply with many of the quality management metrics (quality system, internal processes, corresponding monitoring and environmental impact).
4. **Environment—quality management and technological process**: smart environment indexes (physical landscape's attractivity, pollution, protection and sustainable management) (Giffinger et al. 2007) meet quality management (environmental impact) and technological process context (development resources).

Table 5.6 a quadruple-helix model for smart city capacity measurement (Lombardi et al. 2012)

	Clusters				
Quadrable helix	Smart governance	Smart economy	Smart human capital indicators	Smart living	Smart environment
University	No. of universities and research centers in the city	Public expenditure on R&D—percentage of GDP per head of city population	Percentage of population aged 15–64 with secondary-level education living in Urban Audit	Percentage of professors and researchers involved in international projects and exchange	An assessment of the ambitiousness of CO_2 emission reduction strategy
	No. of courses entirely downloadable from the internet/total no. courses	Public expenditure on education—percentage of GDP per head of city population	Percentage of population aged 15–64 with higher education living in Urban Audit	Number of grants for international mobility per year	An assessment of the extensiveness of city energy efficiency standards for buildings
		Number of research grants funded by international projects	Percentage of inhabitants working in education and in research & development sector	Percentage of accessible courses for people with disabilities (PWD)	
Government	e-Government on-line availability (percentage of the 20 basic services that are fully available online)	GDP per head of city Population Debt of municipal authority per resident	Voter turnout in national and EU parliamentary elections Share of female city representatives	Proportion of the area in for recreational sports and leisure use Green space (m^2) to which the public has access, per capita	Total annual energy consumption, in gigajoules per head Efficient use of electricity (use per GDP)

(continued)

Table 5.6 (continued)

	Clusters				
Quadrable helix	Smart governance	Smart economy	Smart human capital indicators	Smart living	Smart environment
	Percentage of households with computers	Median or average disposable annual household income Unemployment rate	City representatives per resident	Number of public Libraries Number of theaters and cinemas	Total annual water consumption, in cubic meters per head Efficient use of water (use per GDP)
Civil society	Percentage of households with Internet access, at home	Energy intensity of the economy—gross inland consumption of energy divided by GDP		Health care expenditure—percentage of GDP per capita Tourist overnight stays in registered accommodation in per year per resident	Area in green space (m^2) Greenhouse gas emission intensity of energy consumption An assessment of the comprehensiveness of policies to contain urban sprawl and to improve and monitor environmental performance Urban population exposure to air pollution by particulate matter—micrograms per cubic meter
	e-Government usage by individuals (percentage individuals aged 16–74 who have used the Internet, in the	Percentage of projects funded by civil society	Foreign language skills Participation in life-long learning (%)	Total book loans and other media per resident Museum visits per inhabitant	The total percentage of the working population traveling to work on public transport, by bicycle and by foot

(continued)

Table 5.6 (continued)

	Clusters				
Quadrable helix	Smart governance	Smart economy	Smart human capital indicators	Smart living	Smart environment
	last 3 months, for interaction with public authorities)		Individual level of computer skills	Theater and cinema attendance per inhabitant	An assessment of the extent to which citizens may participate in environmental decision-making An assessment of the extensiveness of efforts to increase the use of cleaner transport
Industry	Number of research grants funded by companies, foundations, institutes/No annual scholarships	Employment rate in: – High Tech and creative industries – Renewable energy and energy efficiency systems – Financial intermediation and business activities – Culture and entertainment industry	Patent applications per inhabitant Employment rate in knowledge-intensive sectors	Number of enterprises adopting ISO 14000 standards Proportion of people undertaking industry-based training	The percentage of total energy derived from renewable sources, as a share of the city's total energy consumption, in terajoules Combined heat and power generation—percentage of gross electricity generation Proportion of recycled waste per total kilogram of waste produced

(continued)

Table 5.6 (continued)

	Clusters				
Quadrable helix	Smart governance	Smart economy	Smart human capital indicators	Smart living	Smart environment
		– Commercial services – Transport and communication – Hotels and restaurants All companies (total number)			

Table 5.7 A model that measures the innovation capacity of a company (Maital and Seshadri 2007)

Strategy and planning	Marketing	Technological process	Quality management	Logistics	Human resources
Idea about the company's future	Monitoring of current market trends	Future company's competitiveness in the industry	Monitoring of changes conditioning the quality management in the company	Organization of purchase and distribution channels in the company	Employees satisfaction
Vision and employees	Evaluation of the market competition position	Changes of technologies	Employees' personal contribution to the quality system	Optimization of the company logistics	Employees motivation
Company innovation programs	Customer-orientation	Collection of impulses for implementation of technology changes	External quality audit in the company	Information and communication flows between the company and its partners	Management and communication
Plan modifications	Monitoring of customers' attitudes to the company product	Evaluation of the return on investment	Monitoring of the environmental impact	Flexibility of logistics processes	Conflict resolution
Financial indicators of the plan	Market information flow inside the company	Calculation of production costs and their monitoring	Impact of quality monitoring on the company processes	Introduction of innovations in logistics	Company information system
Project management	Marketing and financial control	Creation of resources for development	Covering of costs resulting from modifications of standards, regulations and legislation in the sphere of quality and environment	Logistics and financial control	Company culture

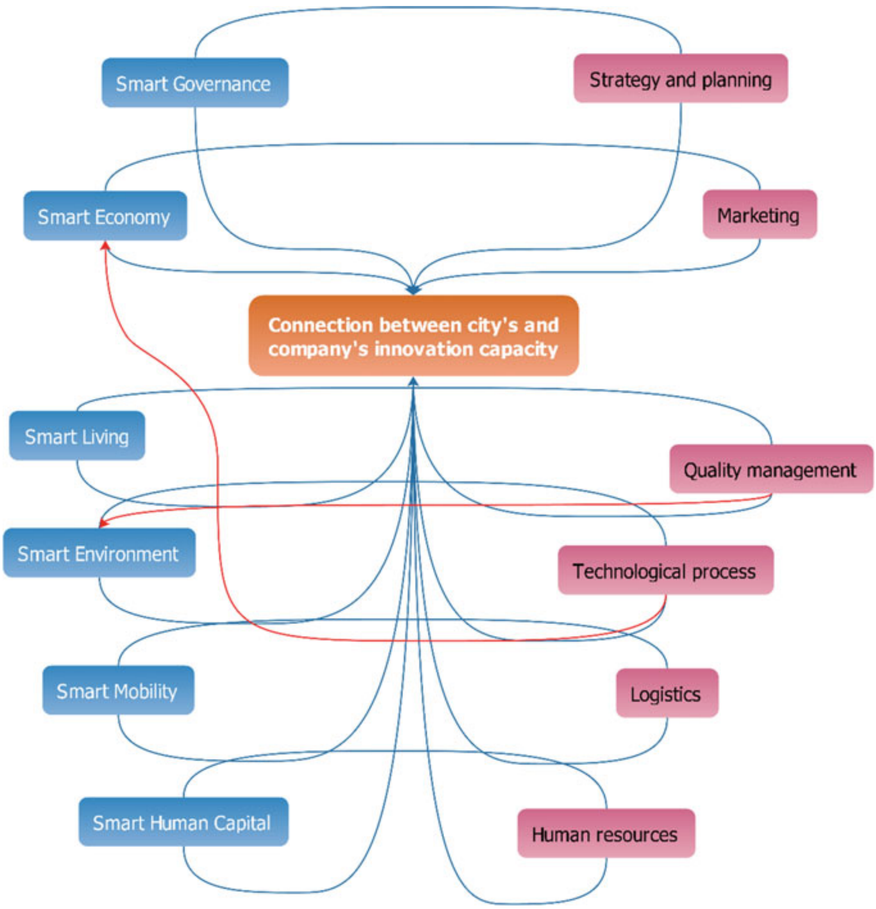


Fig. 5.12 A comparison between city and business innovation capacity models

5. **Mobility—logistics**: smart mobility metrics (accessibility, infrastructure availability, sustainability and safety) meet logistics requirements (distribution channels, information flow and flexibility).
6. **Human capital (people)—human resources**: finally, smart people indexes (qualifications, plurality, creativity, open-mindedness and participation) align to human resource context (culture and motivation).

5.4.3 An Innovation Management Model for Smart City

Both the above models depict the existence of the necessary innovation prerequisites within the city's ecosystem, which concern (Maital and Seshadri 2007) knowledge (smart people), risk-taking (people), motivation (people) and access to finance (economy). In this regard, the smart city appears to be the outcome of a bottom-up process according which, the local community demands urban enhancement, which can partially be offered by the private sector (vendor innovation). However, smart people influence governments too, either from the demand side (require a change) or from the supply side (via being engaged in the policy making process).

In this respect, public sector innovation is another parameter that results to smart city development. This concept of innovation in the public sector has shifted "from a value-based concept into a concrete goal with specific targets," including "innovation" as a specific performance objective for government administrators (Gil-Garcia et al. 2014). From this point of view, innovation is tied to specific strategic goals and objectives and several organizational changes are necessary to be performed. The New York Police Department for instance, adopted Compstat that "combine[s] real-time geographic information on crime with strong accountability by middle managers in the form of daily group meetings".

Regardless the innovation capacity or the innovation source (private or public sector), it is realized that smart city is an innovative product (or portfolio of innovative products). In this regard, it is interested to recognize the corresponding development process (Fig. 5.13) by viewing the smart city as an individual innovation (system or a solution to a single problem).

Step 1: follow suggestions

Literature (Howells 2005; Maital and Seshadri 2007) provide with specific "dos and don'ts" innovation development: first, the innovator (the smart city owner) is important to understand local community's insights (what are local needs and expectations) and to try to solve them with simple solutions that the community can

Fig. 5.13 The smart city—as innovation development process

easily adopt. Finally, the innovation must be developed at a small scale (e.g., primary smart service deployment, smart district development) and then expose to the city level. Furthermore, the innovator must not be too sophisticated, he has to deal with each problem at a time (don't do many things at once), while each innovation has to deal with recent problems that the community understands and not with future ones (innovate for today). All the successful smart city cases that were presented in Chap. 3 succeeded in the above suggestions, they started from engaging the stakeholders to understand their needs; they moved to small scale development of solutions that deal with individual problems (e.g., focus on transportation); they developed simple smart services step by step (e.g., first solve the waste management problem) and they solve today problems. Only the large scale successful cases have moved with planning for 2030 and one for 2050 (Anthopoulos 2017).

Step 2: secure conditions for success

Innovation is the outcome of hard work and in this respect, only dedicated owners can succeed. Moreover, the smart city has to be important to the owner and believe in its potential. These two conditions validate that only in cities where the owner (e.g., the government) assigned dedicated management succeeded in its mission (e.g., Vienna). Finally, innovation must be controlled by the market (market-pull) and not from the existence of technology (technology push). This last condition validates smart city criticizers (Anthopoulos 2017), who claim that governments have partnered with big smart city vendors and develop outstanding projects that mostly serve individual interests.

Step 3: adopt an implementation model

Four types of implementation models exist for innovation management Maital and Seshadri 2007):

1. *Descriptive*: describe and evaluate actual practice, which is good for both researchers and practitioners.
2. *Normative*: recommend an ideal process, which is good even for students.
3. *Management:* visualize development activities systematically, which is good only for practitioners.
4. *Didactic*: visualize and simplify development activities, which is good only for students.

A management model can be utilized to demonstrate how a smart city (as an entire system) can be managed in terms of an innovation project. Such a management model is the *Stage-Gate* (*SG*) *process*, which was introduced by Cooper (1994). This model (Fig. 5.14) consists of five (5) development stages, where the innovation progressively evolves. The development flow is a straight-forward process and passes from five (5) gates, which concern several criteria [compulsory (must-meet) and optional (should-meet)] that control this development.

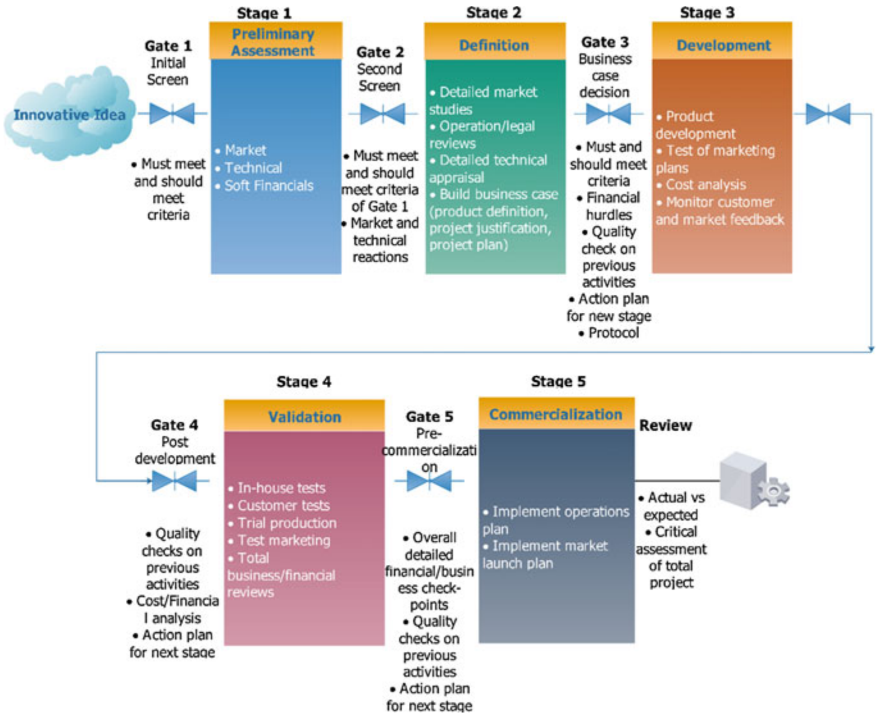


Fig. 5.14 The stage-gate development process (Cooper 1994)

A careful look at the SG process shows that the development of a smart city starts with an initial screening (Gate 1) of its potential and political will and the smart city owner decides whether to proceed with an analysis or not. Then, a preliminary assessment is performed (Stage 1), with regard to the local market (market pull); local technical capacity; and of soft financials. If the results of this analysis show that the smart city appears feasible to be implemented and to succeed in its mission (Gate 1 results again), a second screening (Gate 2) estimates market reaction with regard to meet local needs and secure adoption. In case data pass this comparison, the smart city is defined in detailed with regard to project scope and planning (Stage 2)—like Sect. 5.3 showed—and a business case is being developed (e.g., specific business models define the added value from the smart city to several customer segments). Another check (Gate 3) performs financial hurdles on the identified project to decide the business case and authorizes or declines project development (Stage 3). An additional check (Gate 4) confirms whether the initially grounded requirements are met (quality control), calculates updated financials and authorizes or declines deliverables' validation (e.g., on smart infrastructure and smart services) (Stage 4) with trials and in-house tests. Finally, pre-commercialization tests (Gate 5) perform quality and financial checks on the deliverables and secure project launch (State 5). In the end, an overall review

Table 5.8 An innovation management model for smart city (Nam and Pardo 2011)

	Innovation *How can we change the way delivers service?*	Risk *What are the risks from innovation?*	Way to Success *How can we deal with risks while innovating?*
Technology (to serve as a tool for innovation)	• Leveraging transformational potentials of advanced ICT	• Lack of knowledge • Incompatibility • Overestimation (too much hope) • Security	• System interoperability • Integration of systems and infrastructures
Organization (to manage innovation)	• Efficient and effective management • Inter-governmental interoperability	• Organizational conflicts • Resistance to change • Misalignment between goals and projects	• Enterprise interoperability and business modeling • Cross-organizational management and managerial interoperability • Leadership
Policy (to create an enabling environment)	• Redesigning relationship between government and stakeholders • Policy Experiment	• Stakeholders' underestimation • Political pressure • Policy conflicts	• Policy integration • Marketing • Governance • Collaboration • Partnership
Context	• Physical dimension • Environment • Level of interactions		• Consideration of context

demonstrates project changes with a comparison between the initial concept and the final product, while the overall project performance is being assessed.

Beyond the adoption of a clearly innovation development model, literature returns several works that deal with smart city as urban innovation. Nam and Pardo (2011) for instance, introduce a management model that attempts to handle the innovative character of a smart city in terms of technology, organization, policy and context (Table 5.8) and provides with guidance risk management that comes from uncertainties, complexities, organization inefficiencies or mistaken management.

Revision Question 1:	why should a smart city is seen as innovation?
Revision Question 2:	how can local innovation potential be measured?
Revision Question 3:	what is the process to develop a smart city as innovation?
Revision Question 4:	describe an innovation management model of your preference.

5.5 Service Deployment Within Smart City: An Example from Energy Efficiency

Regardless the smart city owner considers the mission from a project or from an innovation perspective, the implementation is a progressive effort that deploys several types of smart infrastructure and services. The installation of hard infrastructure is similar to all types of construction or engineering projects and demands corresponding control. However, the deployment of a smart service—especially when it requires corresponding decision making or long-term planning—is quite a harder process, which requires a policy making process too.

Anthopoulos and Giannakidis (2016) attempted to demonstrate and standardize such a policy making process with Task-Based Modeling (TBM). More specifically, since existing smart city standards (see Chap. 3) do not deal with service or process standardization, which can be defined in alternative ways (Villalba-Diez and Ordieres-Mere 2015), all of which agree with regard to the identification and unification of variants and the establishment of information interchange between different systems or components. Moreover, process standardization describes the extent to which the organization follows recurrent processes and adheres to established standards (Moore 1979). Process standardization enables performance measurement and sets the basis for continuous improvement. Different process modeling approaches can be found in literature, which have been applied on different industrial sectors [e.g., construction (Villalba-Diez and Ordieres-Mere 2015; Ngai et al. 2013); car industry (Herrmann et al. 2015), business and management (Chou et al. 2015; Egyedi and Muto 2012), Information Technology (IT) (Egyedi and Muto 2012; Teachout 2009; Reyneri 1999) and Health (Young et al. 2010) etc.]. In fact, software process standardization appears to have positive impact on software flexibility and project performance (Moore 1979). Some important models that were discovered in this literature review concern the TBM (Shi et al. 2008) and the Plan-do-check-act cycle (Russel 2003; Yu-Chih Liu et al. 2008).

Defining a policy making process is not a simple procedure, since it varies according to the context of the drafted policy. The provided example (Anthopoulos and Giannakidis 2016) focuses on policy making regarding transforming a city to a more energy efficient one. Energy efficiency is one of the primary smart city challenges and many solutions have been suggested for cities like smart buildings, renewable energy units' and smart grid's installation etc., which seem to have only temporary effect on their mission achievement. This argument obliged the authors to look for alternatives in an attempt to define a proper policy making process.

The case study of the project InSmart (Integrative Smart City Planning) (http://www.insmartenergy.com/) can be utilized in this respect (see Sect. 3.1.2). The aim of this project is multi-dimensional and its tasks concern the following: (a) it investigated the potentially different sources of energy supply and demand within the involved cities; (b) it defined a reference framework (baseline) for energy demand calculation in the project's start, with the use of data coming from 2012; (c) it collected scenarios from all the involved cities regarding policy making for energy efficiency; (d) it developed a model for energy demand prediction by 2030, which can test the contributed scenarios; (e) it involved city stakeholders in all the partner cases in order to execute a MCDM for scenarios' prioritization; (f) it calculated scenarios' effect on policy targets. Today, this project finalizes the outcomes from the final calculation in all the involved cities (task f). In the city of Trikala in Greece, the above tasks resulted to the following outcomes:

(a) **Reference framework**: the baseline accounted that Trikala is organized in 20 zones, inhabited by a smoothly increasing population, while the majority of buildings are mainly used for housing purposes.
(b) **Energy demand sources**: buildings (organized in 4 typologies); water and sewage process; waste chain; and transportation.
(c) **Energy supply sources**: heating oil; transportation diesel and gasoline, natural gas; solar panels; and biomass.
(d) **Scenarios definition**: 15 alternative scenarios were tested by the model and the calculated outcomes were compared with the reference framework (baseline). These 15 scenarios concerned alternative energy savings policies that are being considered or being developed by the Municipality of Trikala, in order to comply with the Covenant of Mayors for Climate & Energy objectives,[4] which had signed. This mix of scenarios (Table 5.9) concerns various activities that address all the 5 energy demand sources and result to energy savings.
(e) **Scenarios execution**: calculations regarding the estimated cost and the energy efficiency's outcome of each scenario were performed with the use of the project's models, accompanied by maintenance costs and potential income. The analysis was performed using a City Energy System Model based on the TIMES model generator (Loulou et al. 2005). TIMES (an acronym for The Integrated MARKAL-EFOM System) is a least cost optimization model generator developed by the ETSAP IEA Technology Cooperation Programme (http://iea-etsap.org/). The TIMES energy economy is made up of producers and consumers of commodities such as energy carriers, energy services, and emissions. The model's objective is to minimize the total cost of the energy system, satisfying a number of constraints related to the availability of energy resources, availability of funds to invest in energy efficiency measures and limits of green-house-gas (GHG) emissions etc. The model outputs include the flows of energy forms and their prices, the required level of investments in energy technologies and the associated cost, the annual operation and maintenance costs of each component of the energy system and GHG emissions. The model was adopted in order to represent the energy system of Trikala and then to run the alternative scenarios presented in Table 5.9. The model results were used to calculate the quantitative criteria (first five criteria in Table 5.10) of the MCDM analysis (Fig. 5.15). These results show that each policy results to different outcomes, which have to be evaluated and selected properly. The calculation functions' presentation is beyond the purposes of this chapter.

[4]http://www.covenantofmayors.eu/index_en.html.

Table 5.9 Scenarios definition (Anthopoulos and Giannakidis 2016)

Group	Scenario
Buildings	1. Municipal building renovation (20% improved efficiency) 2. 80% of city buildings connected with the natural gas network 3. Renovation of all city buildings grounded before 1950 4. Energy efficient upgrade of all city buildings
Public lighting	5. Lights' replacement with LED
Renewable energy	6. Renewable energy production by 10% of total demand
Green spaces	7. Green Open Space creation (5% cooling demand reduction)
Transportation	8. Mobility Ring-Road (8C) and Cycle Lane Network with 5–10 km (8R) 9. Replacement of 10 municipal vehicles with electrical ones 10. Encouraging hybrid and electrical vehicle use (e.g., with tolls in the city entrance)
Water and sewage	11. Biomass landfill (950 KWh production capacity) 12. Sewage treatment with bacteria (25% decrease of energy demand) 13. Dam construction (200 KWh)
Systemic	14. Solar panels on all terraces. 15. 20% of CO_2 production decrease

Table 5.10 MCDM criteria definition (Anthopoulos and Giannakidis 2016)

1. Implementation Cost
2. Implementation Cost Efficiency
3. Energy savings
4. Operation and Maintenance Cost
5. Revenue Production
6. Ease of Implementation
7. City's Quality of Life Improvement
8. City's Economic Development Improvement
9. Social Acceptance

(f) **Scenarios' criteria selection definition**: an MCDM process was followed with the contribution of the city stakeholders (Municipality, Commercial Chamber, Technical Chamber and Commercial Association), which play significant economic roles within the city. The purpose of the MCDM was to define and prioritize the criteria for scenarios selection and then to demonstrate how this prioritization affects the selection. A set of 9 criteria were defined and evaluated by the stakeholders (Table 5.10) with the use of the PROMETHEE Decision Making methodology. The first five criteria in the table are quantitative and are defined as the difference of the value of the parameter in the baseline scenario, compared to its value in the scenario under consideration. For instance, energy savings are defined as total energy consumption in the baseline scenario, minus total energy consumption in the policy scenario; while implementation cost is defined as the difference between investment costs in the policy scenario minus investment cost in the baseline scenario.

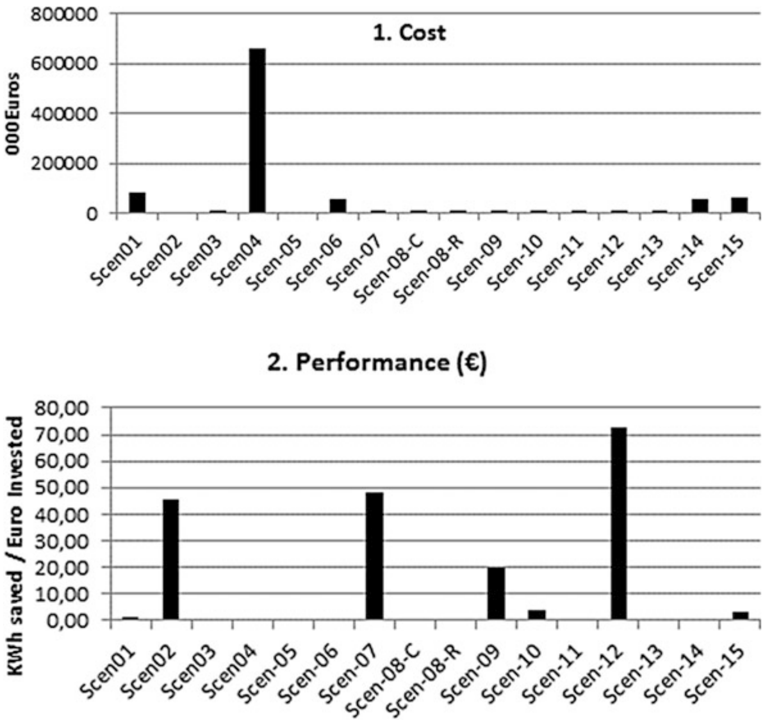


Fig. 5.15 Scenarios simulation (Anthopoulos and Giannakidis 2016)

The implementation cost efficiency is the ratio of these two quantities expressing the amount of money (in Euro) per KWh that is being saved in the implementation of each scenario. Generated income refers to the income that is produced for the citizens and the municipality from the sales of electricity produced by renewable energy sources [mainly photovoltaic stations (PVs)]. Stakeholders' inputs in the MCDM process were given to the corresponding software application and all the scenarios were prioritized accordingly. The PROMETHEE MCDM is quite similar to the ELECTRE (presented in Chap. 4) and it is suitable for problems with limited options (alternatives), while it results to prioritized decisions, according which the decider makes a selection. It uses both quantitative and qualitative criteria for options' prioritization, while variables (weights) are calculated and assigned to these criteria. Moreover, this method compares the alternatives in pairs, according to each criterion and to decider's preferences. In order for the criteria weights' to be calculated according to the decider's preferences, a 2-dimensional matrix is used, where each criterion is compared with all the remainders.

According to the Task-Based Modeling method (TBM) (Shi et al. 2008), a process has to be analyzed in key management tasks and each task is accompanied

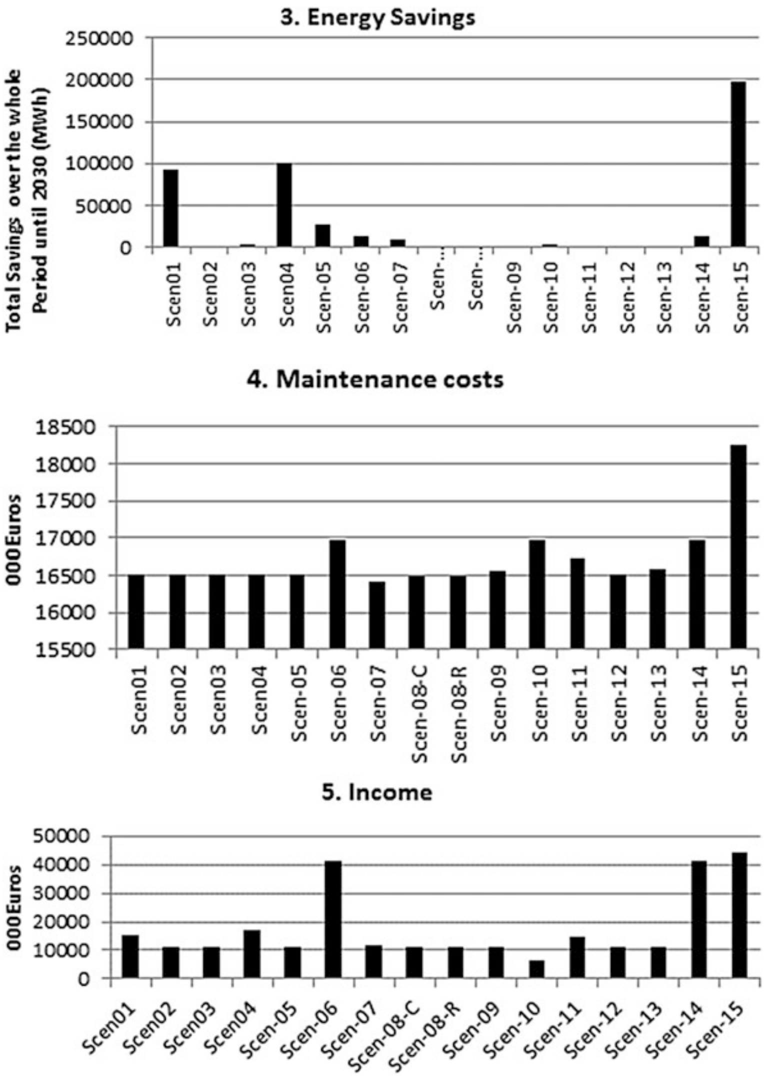


Fig. 5.15 (continued)

by an execution method and by detailed attributes. Instead of trying to standardize a business process, TBM intends to focus on standardizing lower level management tasks. TBM enables the clear definition and the outcome's measurement of a process. A management task represents a management action or a series of actions to be taken in order to achieve specific object or function. To this end, each management task has the following features, regardless its complexity (Shi et al. 2008):

- Action: it takes an action or a series of related actions to execute a task. An action is characterized by a "verb";
- Method: it may be conducted with certain methods;
- Object: the action may work on an object that affects the means of executing a task.

Management tasks can be *fully* or *semi-automated* or *fully manual* (Shi et al. 2008). Fully automated tasks can be conducted by computers via the appropriate software (e.g., the action *send_email[what, whatElse]* sends an e-mail message with content "what" to recipients "whatElse"). Semi-automated tasks on the other hand, require the interaction between a decider and the computer during a task (e.g., retrieving historical spending data with adjustments made by a human). Finally, manual tasks concern complex decision making tasks, which can be only performed by qualified humans.

A management process is driven by a request—which is a question, a process or a need—and it is executed with the following steps (Shi et al. 2008): (a) raise a request; (b) create an instance of a process model; and (c) execute the model—task by task—and trace the dynamic status of the model.

All the above information can be adjusted with the process that was presented above, where policy making was analyzed in 6 specific tasks (a–f). The extracted TBM (Anthopoulos and Giannakidis 2016) consists of a total of 17 tasks, it is depicted on (Fig. 5.16) and may vary between cities. Although this model has been defined for energy efficiency purposes in smart cities, it is quite generic and it may be applicable in other corresponding policy making problems too, since it incorporates a MCDM process and defines decision options and corresponding criteria.

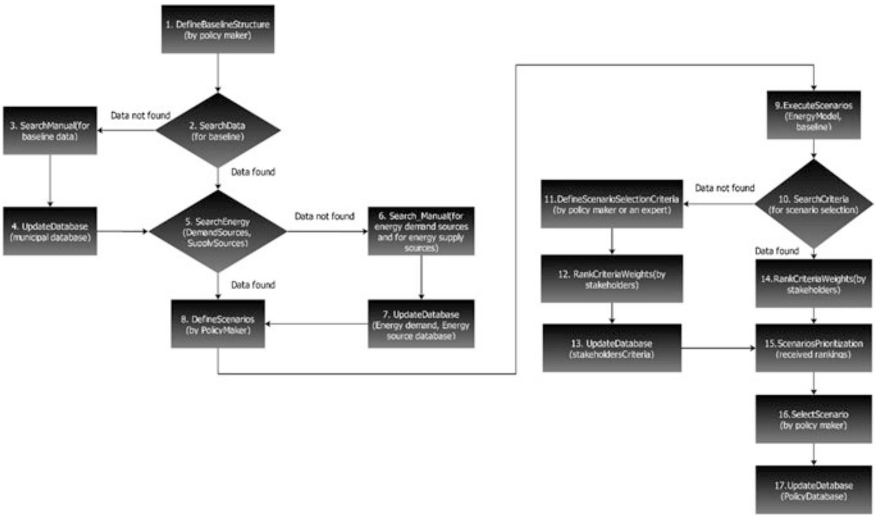


Fig. 5.16 The policy making process model (Anthopoulos and Giannakidis 2016)

Table 5.11 The analysis of the proposed TBM process (Anthopoulos and Giannakidis 2016)

<table>
<tr><th>[1] Task Code</th><th>[2] Action</th><th>[3] What</th><th>[4] WhatElse</th><th>[5] Description of action</th></tr>
<tr><td>1.</td><td>[6] DefineBaselineStructure</td><td>[7] DefinedBaselineStructure</td><td>[8] Policy maker or an expert</td><td>[9] Policy maker or an expert defines the baseline structure</td></tr>
<tr><td>2.</td><td>[10] SearchDatabase</td><td>[11] 6. BaselineDataExist = yes
[12] 4. BaselineDataExist = no</td><td>[13] BaselineDatabase—a database name</td><td>[14] Select a route based on whether or not baseline information is found</td></tr>
<tr><td>3.</td><td>[15] Search_Manual</td><td>[16] City, Population, Energy Suppliers, Energy Consumers, Traffic Data, Emission Production, Water and Sewage, Waste Management</td><td>[17] Policy maker or an expert</td><td>[18] Policy maker investigates the city for the required information for the baseline</td></tr>
<tr><td>4.</td><td>[19] UpdateDatabase</td><td>[20] ID#|City|BaselineParameter|BaselineValue</td><td>[21] BaselineDatabase—a database name</td><td>[22] Automated task: Update the database with the Baseline data</td></tr>
<tr><td>5.</td><td>[23] SearchDatabase (5.1, 5.2)</td><td>[24] 9: SuppliersExist = yes AND ConsumersExist = yes
[25] 7: SuppliersExist = no OR ConsumersExist = no</td><td>[26] EnergySource—a database name
[27] EnergyDemand—a database name</td><td>[28] Select a route based on whether or not energy suppliers and consumers are found</td></tr>
<tr><td>6.</td><td>[29] Search_Manual</td><td>[30] Energy Demand,
[31] Energy Production Source</td><td>[32] Nil</td><td>[33] Policy maker or an assigned expert identifies a set of energy suppliers (sources) and energy consumers (demands)</td></tr>
<tr><td>7.</td><td>[34] UpdateDatabase (7.1, 7.2)</td><td>[35] ID#|EnergySource
[36] ID#|EnergyDemand</td><td>[37] EnergySource—a database name
[38] EnergyDemand—a database name</td><td>[39] Automated tasks: Update the first database with the identified energy supplier sources and the second database with the identified energy demands</td></tr>
<tr><td>8.</td><td>[40] DefineScenarios</td><td>[41] DefinedScenarios</td><td>[42] Policy maker or an expert</td><td>[43] Policy maker or an assigned expert defines a set of scenarios (policy options)</td></tr>
</table>

(continued)

Table 5.11 (continued)

[1] Task Code	[2] Action	[3] What	[4] WhatElse	[5] Description of action
9.	[44] ExecuteScenarios	[45] EnergyModel, baseline	[46] Nil	[47] Automated task: the identified scenarios are tested regarding their efficiency with the identified model
10.	[48] SearchCriteria	[49] 15: CriteriaExist = yes [50] 12: CriteriaExist = no	[51] Nil	[52] Select a route based on whether or not selection criteria are found
11.	[53] DefineScenarioSelectionCriteria	[54] DefinedCriteria	[55] Policy maker or an expert	[56] Policy maker defines a set of criteria, for scenario selection
12.	[57] RankCriteriaWeights	[58] RankedCriteria	[59] Stakeholders	[60] The stakeholders rank the MCDM criteria
13.	[61] UpdateDatabase	[62] ID#|Criterion| CriterionWeight	[63] StakeholdersCriteria—a database name	[64] Automated task: Update the selected criteria database
14.	[65] RankCriteriaWeights	[66] RankedCriteria	[67] Stakeholders	[68] The stakeholders rank the MCDM criteria
15.	[69] ScenariosPrioritization	[70] RankedCriteria	[71] Nil	[72] Automated task: scenarios are prioritized according to criteria weights
16.	[73] SelectScenario	[74] Top ranked Scenario	[75] Policy maker	[76] The policy maker makes decision based on the optimal scenario according to MCDM results
17.	[77] UpdateDatabase	[78] ID#|Scenario|Rank	[79] PolicyDatabase—a database name	[80] Automated task: Update the selected scenario database

Table 5.12 Alternative smart city operational management types (Anthopoulos and Fitsilis 2014)

Category	Representatives found in literature and the year of their appearance	Outcomes from further investigation of the identified cases
Web/Virtual City	5. **America-On-Line (AOL) Cities** (1997) 6. **Kyoto**, Japan (1996–2001) http://www.digitalcity.gr.jp 7. **Bristol, U.S.A.** (1997) 8. **Amsterdam** (1997)	2. **America-On-Line (AOL) Cities** (Private Company) City Guides for U.S. cities http://www.citysbest.com 3. **Bristol, U.S.A.** (Municipality appointed the Project to a Private Company) http://www.digitalbristol.org/ 6. **Craigmillar Community Information Service** Scotland. (Municipal Service) http://www.s1craigmillar.com
Knowledge Bases	35. **Copenhagen Base** (1989) 36. **Craigmillar Community Information Service,** Scotland (1994) 37. **Blacksburg Knowledge Democracy**, U.S.A. (1994)	
Broadband City/ Broadband Metropolis	38. **Seoul**, S. Korea (1997) 39. **Beijing**, China (1999) 40. **Helsinki** (1995) 41. **Geneva-MAN**, Switzerland (1995) 42. **Antwerp**, Belgium (1995)	11. **Geneva-MAN**, Switzerland It began as a public investment, which by 2003 assigned the extension and operation to a Private Company, while the State keeps the control (possible SOE)
Wireless/Mobile City	43. **New York** (1994) 44. **Kista Science City/Stockholm** (2002) 45. **Florence,** Italy (2006)	13. **New York** It operates under the New York City Department of Information Technology & Telecommunications (DoITT) (SOE) http://www.nyc.gov/html/doitt/ 14. **Kista Science City/Stockholm** ICT partnership between companies and the Municipality (possible SOE) http://en.kista.com 15. **Florence,** Italy It operates under the Municipality (possible SOE). http://senseable.mit.edu/florence/

(continued)

Table 5.12 (continued)

Category	Representatives found in literature and the year of their appearance	Outcomes from further investigation of the identified cases
Smart City	46. **Taipei**, Taiwan (2004) 47. **Tianjin**, China (2007) 48. **Barcelona**, Spain (2000) 49. **Brisbane**, Australia (2004) 50. **Malta** (2007) 51. **Dubai** (1999–today) 52. **Kochi,** India (2007)	10. **Helsinki** It has been evolved from a Wireless City, it is funded by European Framework Programs and encourages privatization (possible SOE) http://www.hel.fi 12. **Antwerp**, Belgium Evolved from Broadband City; it is interconnected to Brussels and to Amsterdam (Baeyens 2008); offers its infrastructure with the open access business model; it operates under the Municipality and invites private investments (possible SOE). 19. **Brisbane**, Australia Exists and limited its scope to local e-Government, traffic and parking services, and on waste management. It operates under the Municipality (possible SOE). http://www.brisbane.qld.gov.au 20. **Malta** Continues to connect ICT companies especially in the field of healthcare and education. Self-sustained township, is the result of a private investment http://malta.smartcity.ae/ 21. **Dubai** Exists and continues to integrate top ICT solutions It is the result of a private investment www.dubaiinternetcity.com www.dubaimediacity.com 22. **Kochi**, India Self-sustained township, is the result of a private investment, State Government of Kerala, India. http://www.smartcity.ae
Digital City	53. **Hull**, U.K. (2000) 54. **Cape Town,** South Africa (2000) 55. **Trikala**, Greece (2003) 56. **Tampere**, Finland (2003) 57. **Knowledge Based Cities**, Portugal (1995)	9. **Beijing**, China It evolved from a broadband city (Qi and Shaofu 2001) Alliance between the Municipality and a private company (possible SOE). 7. **Blacksburg Electronic Village**, U.S.A. It updated its mission and evolved from a knowledge base, it serves local

(continued)

Table 5.12 (continued)

Category	Representatives found in literature and the year of their appearance	Outcomes from further investigation of the identified cases
	58. **Austin**, U.S.A. (1995—today)	community and operates with the partnership between Municipality, the local university and a private operator (Carroll 2005) (possible SOE) http://www.bev.net/ 23. **Hull**, U.K. Exists and focuses on e-Government, on e-learning and on smart TV It is funded by European Framework Programs; offers its infrastructure with the open access business model; it operates under the Municipality and encourages privatization (possible SOE) http://www.hullcc.gov.uk 24. **Cape Town,** South Africa Exists and offers various e-services such as environmental, for tourism, transportation. It is a public program that invites PPE (possible SOE) http://www.capetown.gov.za 25. **Trikala**, Greece Exists and limited its scope to tele-care and to metro-Wi-Fi services It is funded by European Framework Programs; offers its infrastructure with the open access business model; it operates as a Municipal Company (possible SOE) www.e-trikala.gr 26. **Tampere**, Finland It began as a thinking tank for innovative ICT applications. Today it occupies more than 1000 professionals who develop various e-Services It is funded by European Framework Programs; offers its infrastructure with the managed business model; it operates under the Municipality http://www.tampere.fi 27. **Knowledge Based Cities**, Portugal Portals of the digital cities have not met projects' objectives They are funded by European Framework Programs; offer their infrastructure with the managed business model; they operate under the Municipality http://www.cidadesdigitais.pt

(continued)

Table 5.12 (continued)

Category	Representatives found in literature and the year of their appearance	Outcomes from further investigation of the identified cases
Ubiquitous City	59. **New Songdo**, S. Korea (2008) 60. **Dongtan**, S. Korea (2005) 61. **Osaka**, Japan (2008) 62. **Manhattan Harbour, Kentucky**, U.S.A. (2010) 63. **Masdar**, United Arab Emirates (2008) 64. **Helsinki Arabianranta**, Finland (2005)	8. **Seoul**, S. Korea Evolved from a broadband city and operates under a coalition of public and private stakeholders (possible SOE) (Korean Ministry of Information and Communications 2012) 29. **New Songdo**, S. Korea Under development (Lee and Ho 2008) It is funded by loans from Korean and international banks and works as a coalition of various public and private stakeholders (SOE) http://www.songdo.com 31. **Osaka**, Japan Under development (Jackson et al. 2011). It operates as a coalition of public and private interests (Morita and Sanada 2003) (possible SOE) http://www.osakacity.or.jp 32. **Manhattan Harbour, Kentucky**, U.S.A. Under development. It has been assigned to a private company. http://www.manhattanharbour.com 34. **Helsinki Arabianranta**, Finland Under Development, publicly funded and operated as an innovative living lab (Schaffers and Komninos 2012) (possible SOE) http://www.arabianranta.fi/

(continued)

Table 5.12 (continued)

Category	Representatives found in literature and the year of their appearance	Outcomes from further investigation of the identified cases
Eco City		4. **Amsterdam** It evolved to other approaches (broadband, smart, eco-city) funded by European framework programmes and operates under the Municipality, which encourages private investments (possible SOE) http://www.amsterdamsmartcity.com 5. **Copenhagen** It has evolved from a knowledge base, funded by European framework programmes and operates under the Municipality, which encourages private investments (possible SOE) http://www.kk.dk 16. **Taipei**, Taiwan It has evolved from a Smart City; it is funded by public budget and invites private partnership (possible SOE) http://english.taipei.gov.tw/ 17. **Tianjin (Singapore)**, Under development Public housing project in the Eco-city and Keppel District Heating and Cooling System Plant (possible SOE) http://www.tianjinecocity.gov.sg 18. **Barcelona**, Spain Evolved from a Smart City, funded by European framework programmes and operates under the Municipality, which encourages private investments (possible SOE) http://w3.bcn.es, http://www.bcn.es 28. **Austin**, U.S.A. It began as a digital city and emerged to Eco City. Municipality assigned its operation to a private company. http://www.cityofaustin.org/ 33. **Masdar**, United Arab Emirates Evolved from a ubiquitous city. It is still under development and it is publicly funded (possible SOE). http://www.masdarcity.ae 30. **Dongtan** S. Korea Evolved from a ubiquitous city and operates under the consortium of public and private stakeholders (possible SOE) (Kim et al. 2011).

In (Table 5.11) an analysis of all the steps is demonstrated. In this process model, there are 10 different tasks as follows (Anthopoulos and Giannakidis 2016):

- *DefineBaselineStructure*: a manual task. It requires a manager to define the structure of the baseline.
- *SearchDataBase*: an automated task. It searches records from a given database;
- *UpdateDatabase*: an automated task. It updates a database with new records.
- Search_Manual: a manual task. It involves a manual process to search for a list of qualified items;
- *DefineScenarios*: a manual task. It requires a manager to define the alternative scenarios.
- *ExecuteScenarios*: an automated task. It uses the model and the energy data to calculate policies' efficiency.
- *DefineScenarioSelectionCriteria*: a manual task. It requires a manager to define the selection criteria.
- *RankCriteriaWeights*: a manual task. It requires stakeholders to rank the importance of the selection criteria.
- *ScenariosPrioritization*: an automated task. It uses MCDM methodology to evaluate the scenarios according to the criteria and to their ranking.
- *SelectScenario*: a manual task. It requires a manager to select the optimal scenario.

Revision Question 1:	why it is different to consider smart service deployment compared to smart infrastructure deployment?
Revision Question 2:	what does process standardization mean?
Revision Question 3:	what is the Task-Based-Modeling (TBM) process?

5.6 Conclusions

This chapter showed that the development of a smart city requires careful planning and dedicated implementation management processes. Two alternative approaches were followed, the first of which viewed the smart city as a project, while the second considered smart city as innovation. Both the approaches followed managerial tools: with regard to smart city as project, the PMBOK knowledge areas highlighted 10 different perspectives that the project owner must follow in order to secure project success; with regard to smart city as innovation, a 3-step process must be followed to measure local innovation capacity and to define a focused mission, while a management model can support the owner to avoid possible risks and result to feasible outcomes.

On the other hand, this chapter clarified the meaning of smart city governance and differentiated from smart governance. However, it did not focus on an existing smart city operational management (e.g., organization definition for smart city monitoring), although all existing smart cities have adopted several types of operational management, most of which deal with municipal ownership or PPP (Table 5.12).

Nevertheless, new governance models can be enabled in smart cities, since traditional decision-making processes and project ownership can be disrupted. Smart city creates urgency for leaders to establish new rules of the game. Collaborative design of multi-stakeholder ownership and processes calls for new governance and business models, which are essential to aligning all city services. This cross-functional and inter-organizational collaboration is necessary to unify the increasingly complex ecosystem required to provide end-to-end solutions for Smart Cities. Leading cities have set up dedicated business-relation functions and special-purpose organizations to act in an orchestration role, to look into the various interests of different service sections, and to facilitate dialogue and cross-fertilization of ideas (CISCO 2013).

References

Allwinkle, S., & Cruickshank, P. (2011). Creating smart-er cities: An overview. *Journal of Urban Technology, 18*(2), 1–16.

Anthopoulos, L. (2017). Smart utopia VS smart reality: Learning by experience from 10 smart city cases. *Cities*, forthcoming. doi:10.1016/j.cities.2016.10.005

Anthopoulos, L., & Giannakidis, G. (2016). Task-based process modeling for policy making in smart cities. In *The Proceedings of the 8th ITU Kaleidoscope Academic Conference*, Bangkok, Thailand, November 14–16, 2016.

Anthopoulos, L., Janssen, M., & Weerakkody, V. (2016). A Unified Smart City Model (USCM) for smart city conceptualization and benchmarking. *International Journal of e-Government Research, 12*(2), 76–92.

Anthopoulos, L., & Fitsilis, P. (2014). Smart Cities and their roles in city competition: A classification. *International Journal of Electronic Government Research (IJEGR), 10*(1), 67–81.

Anthopoulos, L., Ipsilantis, P., & Kazantzi, V. (2014). The project management perspective for a digital city. *International Journal of Information Technology Project Management (IJITPM), 5*(1), 45–62.

Anthopoulos, L., Gerogiannis, V., & Fitsilis, P. (2011). Supporting the solution selection for a digital city with a fuzzy-based approach. In *International Conference on Knowledge Management and Information Sharing (KMIS)* (vol. 3, pp. 355–358).

Anthopoulos, L., & Tsoukalas, I. A. (2006). The implementation model of a Digital City. The case study of the Digital City of Trikala, Greece. *Journal of E-Government, 2*(2), 91–109.

Baeyens, H. (2008). A multipolar world of smart city-regions. In *Pr. zb. pod red. Antoniego Kuklińskiego i Krzysztofa Pawłowskiego* (Ed.), *The Atlantic Community - The Titanic of the XXI Century* (pp. 172–181). REUPUS publishing.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., et al. (2012). Smart cities of the future. *European Physical Journal, 214,* 481–518.

Bolivar, M. P. R. (2016). Mapping dimensions of governance in smart cities: Practitioners versus prior research. In *The Proceedings of the 17th International Digital Government Research Conference on Digital Government Research (dg.o '16)*, Shanghai, China, pp. 312–324.

Carroll, J. (2005). The Blacksburg electronic village: A study in community computing. In P. van den Besselaar and S. Kiozumi (Eds.), *Digital cities III: Information technologies for social capital* (pp. 43–65). New York: Springer-Verlang.

Chou, T.-H., Lee, C.-C., & Lin, C.-W. (2015). Using ontological e-services framework to orchestrate e-business process service. *International Journal of Enterprise Information Systems, 11*(2), 65–89.

CISCO. (2013). *The internet of everything for cities: Connecting people, process, data, and things to improve the 'livability' of cities and communities*. Retrieved September 2016, from http://www.cisco.com/c/dam/en_us/solutions/industries/docs/gov/everything-for-cities.pdf

Cooper, R. G. (1994). Third-generation new product processes. *Journal of Product Innovation Management, 11*(1), 3–14.

David, R. F. (2011). *Strategic management (Concepts and cases)* (Global Edition 13e). Pearson Higher Education.

Egyedi, T., & Muto, S. (2012). Standards for ICT: A green strategy in a grey sector. Source of the Document. *International Journal of IT Standards and Standardization Research, 10*(1), 34–47.

Falconer, G., & Mitchell, S. (2012). *Smart city framework: A systematic process for enabling smart+connected communities*. Retrieved August 2016, from http://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/motm/Smart-City-Framework.pdf

Giffinger, R. C., Fertner, H., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. (2007). *Smart cities: Ranking of European medium-sized cities* [online]. Retrieved May 2016, from http://www.smart-cities.eu/download/smart_cities_final_report.pdf

Gil-Garcia, J. R., Helbig, N., & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government Information Quarterly, 31,* I1–I8.

Hamza, K. (2016). Smart city implementation framework for developing countries: The case of Egypt. In J. R. Gil-Garcia, T. A. Pardo, & T. Nam (Eds.), *Smarter as the new urban agenda: A comprehensive view of the 21st century city* (pp. 171–190). Public Administration and Information Technology Series Switzerland: Springer International Publishing.

Herrmann, S., Rogers, H., Gebhard, M., & Hartmann, E. (2015). Co-creating value in the automotive supply chain: An RFID application for processing finished vehicles. *Production Planning & Control, 26*(12), 981–993.

Hollands, R. G. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society, 8,* 61–77.

Hollands, R. (2008). Will the real smart city please stand up? *City, 12*(3), 303–320.

Howells, J. (2005). *The management of innovation and technology: The shaping of technology and institutions of the market economy*. London, UK: Sage Publications.

IBM. (2009). *A vision of smarter cities*. Retrieved October 2016, from http://www-03.ibm.com/press/attachments/IBV_Smarter_Cities_-_Final.pdf

International Electrotechnical Commission (IEC). (2014). *Orchestrating infrastructure for sustainable Smart Cities*. Retrieved August 2016, from http://www.iec.ch/whitepaper/pdf/iecWP-smartcities-LR-en.pdf

Ishida, T., Aurigi, A., & Yasuoka, M. (2009). The advancement of world digital cities. In H. Nakashima, H. Aghajan, & J. C. Augusto (Eds.), *Handbook on ambient intelligence and smart environments* (pp. 939–958). New York, U.S.A: Springer.

Ivy, J. (2008). A new higher education marketing mix: the 7Ps for MBA marketing. *International Journal of Educational Management, 22*(4), 288–299.

Jackson, M., Gardner, Z., & Wainwright, T. (2011). Location-awareness and ubiquitous cities: A report to the U-City Research Institute, Yonsei University, S. Korea. Retrieved December 7, 2011 from http://elogeo.nottingham.ac.uk/xmlui/handle/url/59

Kaplan, S. R., & Norton, P. D. (1996). Translating strategy into action. The balanced scorecard. In *Library of Congress Cataloging-in-Publication Data* (pp. 8–12, 30–32).

Kim, S. M., Kim, J. O., Yun, C. H., Park, J. W., Lee, Y. W., & Yung, H. S. (2011). Security management of a Cloud-based U-City Management System. In *the Proceedings of the 2nd International Conference on Cloud Computing, GRIDs, and Virtualization (Cloud Computing 2011, IARIA)* (pp. 74–78). Rome, Italy, September 25–30, 2011.

Korean Ministry of Information and Communications. (2012). U-city offers endless possibilities for the future of Korea. Retrieved October 29, 2013 from http://eng.nia.or.kr

Landry, C. (2006). *The art of city making*. London: Routledge.

Lee, J., & Oh, J. (2008). *New Songdo City and the value of flexibility: A case study of implementation and analysis of a mega-scale project*. Unpublished Master of Science dissertation, MIT, Boston. Retrieved December 14, 2011, from http://dspace.mit.edu/bitstream/handle/1721.1/58657/317296469.pdf?sequence=1

Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. *Innovation, 25*(2), 137–149.

Loulou, R., Remne, U., Kanudia, A., Lehtila, A., & Goldstein, G. (2005). *Documentation for the TIMES model*. Retrieved November 2016, from http://iea-etsap.org/docs/TIMESDoc-Intro.pdf

Lysons, K., & Farrington, B. (2006). *Purchasing and supply chain management*. Prentice Hall Publishing.

Maital, S., & Seshadri, D. V. R. (2007). *Innovation management: Strategies, concepts and tools for growth and profit*. New Delhi, India: Response Books, Sage Publications Inc.

Meijer, A., & Bolivar, M. P. R. (2015). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences*, *82*(2), 1–17.

Moore, G. E. (1979). Standardization. *Microelectronics Journal, 10*(2), 30–34.

Morita, Y., & Sanada, Y. (2003). Demonstrative experiments of “Ubiquitous Midosuji Boulevard” plan. Retrieved October 28, 2013 from http://www.osakacity.or.jp/en/journal/issues/44/44-003.pdf

Nam, T., & Pardo, T. A. (2011). Smart city as urban innovation: Focusing on management, policy, and context. In *The Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance (ICEGOV'11)* (pp. 185–194).

New Millennium Research Council. (2005). *Not in the public interest—The myth of municipal Wi-Fi networks*. Washington: New Millennium Research Council. Retrieved, December 10, 2011 from http://newmillenniumresearch.org/archive/wifireport2305.pdf

Ngai, E. W. T., Chau, D. C. K., Poon, J. K. L., & To, C. K. M. (2013). Energy and utility management maturity model for sustainable manufacturing process. *International Journal of Production Economics, 146*(2), 453–464.

Ojo, A., Dzhusupova, Z., & Curry, E. (2016). Exploring the nature of the smart cities research landscape. In J. R. Gil-Garcia, T. A. Pardo, & T. Nam (Eds.), *Smarter as the new urban agenda: A comprehensive view of the 21st century city* (pp. 23–48). Public Administration and Information Technology Series Switzerland: Springer International Publishing.

PMI. (2013). *A guide to the project management body of knowledge* (5th ed.). Pennsylvania, U.S.A: Project Management Institute.

Porter, M. (1996). *What is strategy? Harvard business review* [online]. Retrieved September 2011, from http://www.ipocongress.ru/download/guide/article/what_is_strategy.pdf

Qi, L., & Shaofu, L. (2001). Research on digital city framework architecture. In *Info-tech and Info-net, 2001. Proceedings. ICII 2001 - Beijing. 2001 International Conferences* (vol. 1, pp. 30–36). IEEE.

Rafiq, M., & Ahmed, K. P. (1995). Using the 7Ps as a generic marketing mix: An exploratory survey of UK and European marketing academics. *Marketing Intelligence & Planning, 13*(9), 4–15.

Reyneri, C. (1999). Operational building blocks for business process modelling. *Computers in Industry, 40,* 115–123.

Russel, J. P. (2003). How to implement and audit the process approach. *Quality Progress, 35*(12), 71–73.

Schaffers, H., & Komninos, N. (2012). Smart cities as innovation ecosystems sustained by the future internet. Fireball Whitepaper. Retrieved October 28, 2013 from http://www.anci.it/Contenuti/Allegati/White paper Fireball su smart city.pdf

Shi, J. J., Lee, D.-E., & Kuruku, E. (2008). Task-based modeling method for construction business process modeling and automation. *Automation in Construction, 17,* 633–640.

Shwayri, S. T. (2013). A model Korean ubiquitous eco-city? The politics of making Songdo. *Journal of Urban Technology, 20*(1), 39–55.

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307–320.

Teachout, P. (2009). Process standardization. *Flexo, 34*(3), 28–32.

Van Marissing, E., Bolt, G., & Van Kampen, R. (2006). Urban governance and social cohesion: Effects of urban restructuring policies in two Dutch cities. *Cities, 23*(4), 279–290.

Villalba-Diez, J., & Ordieres-Mere, J. (2015). Improving manufacturing performance by standardization of interprocess communication. *IEEE Transactions on Engineering Management, 62*(3), 351–360.

Watson, V. (2013). African urban fantasies: Dreams or nightmares? *Environment & Urbanization*, *26*(1), 215/231. doi:10.1177/0956247813513705

Winch, G. (2009). *Managing construction projects. An information processing approach*. Oxford, UK: Blackwell Publishing.

Yigitcanlar, T., & Lee, S. H. (2014). Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax? *Technological Forecasting and Social Change, 89,* 100–114.

Young, J., Rinner, C., & Patychuk, D. (2010). The effect of standardization in multicriteria decision analysis on health policy outcomes. *Advances in Intelligent Decision Technologies*, vol. 4 of the series Smart Innovation, Systems and Technologies, pp. 299–307.

Yu-Chih Liu, J., Chen, V. J., Chan, C.-L., & Lie, T. (2008). The impact of software process standardization on software flexibility and project management performance: Control theory perspective. *Information and Software Technology, 50,* 889–896.

Chapter 6
Smart Government: A New Adjective to Government Transformation or a Trick?

After reading this chapter, the following questions will be able to be answered:

- *What is smart government*?
- *What are the core elements of the smart government and how it is differentiated from smart city*?
- *What is the role of government and smart government in the era of global urbanization and the Internet of Things*?
- *How can the democratic system be enhanced in a highly-interconnected world*?
- *Which can some future challenges for governments be named in the urbanization era*?

6.1 Defining Smart Government

Smart city and smart government appear to share a common scientific interest, since they structure corresponding research and practice tems like the "Web Applications and Smart Cities (AW4City)[1]", "The Smart Cities and Smart Government Research-Practice (SCSGRP) Consortium[2]" (Cook et al. 2016; Luna-Reyes and Pardo 2015) and the "Beyond Bureaucracy[3]" (Paulin et al. 2016), while calls for mutual scientific tracks, workshops and articles can be located in several conference posts. However, the interconnection between smart city and smart government is quite ambiguous (Anthopoulos and Reddick 2016).

This can be justified by the fact that the keywords "smart government" returned only 79 articles on SCOPUS®, 1870 results on Google SCHOLAR® and 67 articles on Science Direct® (many of which appeared in all these resources) on September

[1]https://aw4city.wordpress.com/.
[2]https://www.ctg.albany.edu/projects/smartcitiesconsortium.
[3]http://research.apaulin.com/research/glossary#beyondbureaucracy.

L.G. Anthopoulos, *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Public Administration and Information Technology 22,
DOI 10.1007/978-3-319-57015-0_6

2016 and it is quite a confusing term due to the alternative meanings that scholars provide. Some of these approaches are given by Mellouli et al. (2014), Cellary (2013) and Puron-Cid (2014), who name it *the extensive use of technology by governments to perform governmental tasks*, while Taylor (2015) and Gil-Garcia et al. (2013, 2015a) relate the terms "smart city" and "government" demonstrating *innovation and intelligence for local or governments as the means to increase their efficiency and effectiveness*.

On the other hand, Harsh and Ichalkaranje (2015) present a different perspective to smart government according which, *governments utilize the power of "data" in their attempt to improve public services; to enable an integrated, seamless service experience; to engage with citizens; to co-develop policies; and to implement solutions for well-being of the community*. The power of data for the development of a smarter government is labeled "data-smart government" by Janowski (2015), it is also adopted by Cornadie and Choenni (2014), while Turle (2010) recognizes shared service provision as the outcome of interoperability and data utilization. Harsh and Ichalkaranje (2015) adopt Rubel's (2014) definition for smart government according which, *government smart transformation follows a four-stage model* (Fig. 6.1) *that enhances citizen participation, information transparency and service integration and improvement*. This definition seems to be followed by Scholl and Al Awadhi (2015), who present a similar model for the eCity Alliance in the U.S. and by Gil-Garcia (2013), who sees a "whole-of-government" result behind this information integration; while Maheshwari and Janssen (2014) recognize the need for public organizations' interconnection too and discuss corresponding interoperability issues; and Netten et al. (2016) consider smart government as the outcome of interoperability between alternative ICT systems.

Although these definitions come close to past e-government ones, the approach that combines "government" and "data" is novel, since open technologies [*like Extensible Markup Language* (*XML*[4]), *JavaScript Object Notation* (*JSON*)[5] *and Geographic JSON* (*GeoJSON*[6])] enable open data and may empower general public in service co-production. However, Harsh and Ichalkaranje (2015) conclude that service co-production is available only at a local level, complying with the above smart government approaches.

Other corresponding definitions to smart government are given by Gil-Garcia et al. (2014), who perform a deep analysis on past approaches to smart government, clarify the term and conclude that *smart government is a creative mix of emerging technologies and innovation in the public sector,* which *can handle complexity and uncertainty with coordination, continued engagement, access to open data, and shared information* (Gil-Garcia and Sayogo 2016). More specifically, they claim that smart government is a continuous effort and not a specific goal, which is supported by a set of emerging technologies (e.g., big data, open government data,

[4]http://www.w3.org/XML/.

[5]http://www.json.org/.

[6]http://geojson.org/.

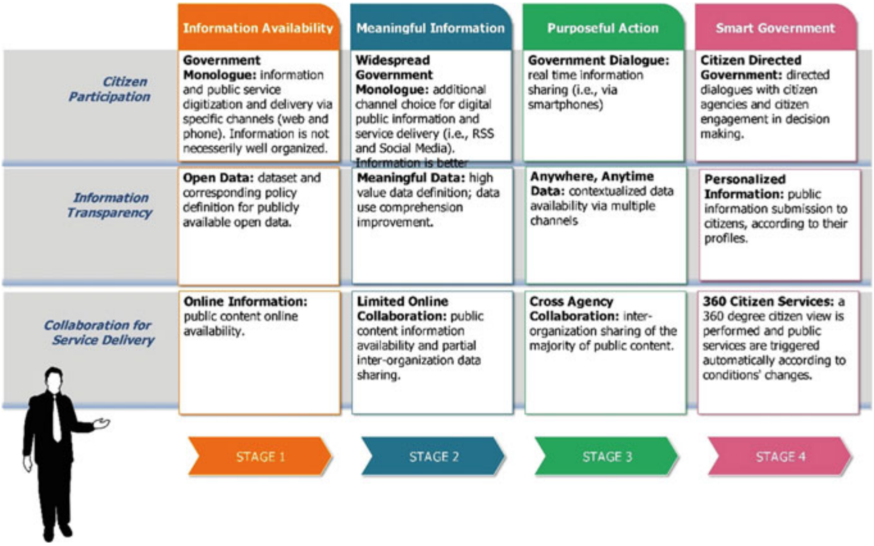


Fig. 6.1 Smart government maturity model (Rubel 2014)

social networking, blogs, Really Simple Syndication (RSS) feeds, web design and programs (e.g., html5, xhtml, SQl, and more), mobile government, smartphone applications, cloud computing, sensors etc.). Criado et al. (2013) determine this creative mix to be the combination of social media, open government and big data (social technologies). This definition has been adopted by Eom et al. (2016), who interrelate this innovation mix with an enhanced government ability—based on smart work—to deal with problem solving and livability at a local level (Scholl and Scholl 2014).

Smart government is also defined as *the next step for e-government, with the use of innovation* (Savoldelli et al. 2014) or as the next step of open government too (Veljković et al. 2014) with the engagement of citizens, accountability and interoperability. The power of interoperability is seen by Jetzek (2016) too, organized in 3 layers (technical, conceptual and organizational). Innovation can lead to the production of new public value, that is 'value created by government through services, law regulations and other actions' and in this respect a triangle (Fig. 6.2) controls the migration from e-government to smart government, which contains the following elements:

- politics (decisions amongst competitive interests and priorities),
- values (symbolic and tangible needs and benefits for the constituency targeted by the decisions), and
- evidence (both about the values and about the ex-ante and ex-post effects of political decisions with respect to the targeted values).

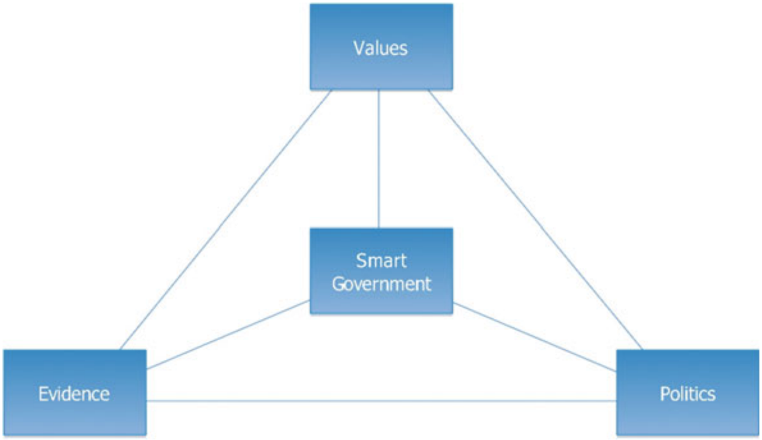


Fig. 6.2 The smart government triangle (Savoldelli et al. 2014)

Ryan et al. (1994) define the key-enabler for smart government to be the trained personnel in the basics of information management and information service delivery. From a similar viewpoint, Linders et al. (2015) consider the transformation of e-government services to pro-active ones, as a means towards smart government, which will drive smart development too, meaning that ICT innovation can in fact serve as an enabler for national growth. Similarly, Jansen and Olnes (2016) adopt European Commission's smart government's conceptualization (European Commission 2012), as the availability of specific e-government key enablers and more specifically of the smart applications eID, eDocuments, eSafe, Single Sign On (SSO) and authentic sources. Such an approach respects the delivery of public e-services to government "beneficiaries" (citizens, enterprises and public organizations). In this regard, e-service can be understood as a sequence of digital interactions between a service provider (government) and service receiver (beneficiary), which add some value to the receiver (Jansen and Olnes 2016).

Jiménez et al. (2014) introduce an intelligent model for public organizations, entitled "Smart Government Ecosystem Matrix". This model is a 2-dimensional matrix that combines *open government* features (transparency, collaboration, participation and interoperability) and *smart city* context (organizational and management, technology and infrastructure, governance and policy, social, economy and natural environment) and defines smart government as the next step of open government. In this respect, Jun and Chung introduced Government 3.0 platform, which shares open data with citizens, government and enterprises.

Moreover, Gil-Garcia et al. (2014) locate a shift of government innovation from a value-based concept into a concrete goal with specific targets, which is used to measure smartness. In this respect, innovation is utilized by governments as a means to gain a good understanding of the communities (being percipient); to accurately assess situations or people (being astute); to judge sharply (being shrewd), and to decide and respond quickly or effectively (being quick). According to their approach, **smart city is only a subset of smart government**, where local governments understand the term "being smart" as their attempts to enhance their efficiency, effectiveness, transparency and collaboration with emerging technologies and innovation.

The above two approaches provided by Jiménez et al. (2014) and Gil-Garcia et al. (2014) are only some of the ones that interrelate smart government and smart city. Many scholars **see smart government within the smart city nexus** and a corresponding research-practice consortium has been structured[7] to investigate this relation. Such a discussion started in Telecities (Dai 2003), where smart government was one of the primary aspects that was being investigated by a corresponding working group. Hashem et al. (2016) discuss big data analytics potential in smart cities for enabling smart governance with the collaboration of agencies that share common interests. Paulin et al. (2016) view smart government as a future government era, where government processes could be performed with no bureaus and citizens will directly co-create democracy with their governments. Hu and Wang (2016) analyzed data from 53 under-development Chinese smart cities and reveal that smart city projects are utilized form smart government development in terms of corresponding policy's and regulation's formulation, public information and service launch, and data management; Nam and Pardo (2014) see *smart city as an area of practice for government innovation*, which enhances government effectiveness and efficiency, service delivery, process transparency and collaboration; quite similarly, Anthopoulos and Reddick (2015) view *smart city as a means for smart government deployment, as well as utilities for recent government challenges' management and new policy development* (i.e., climate change management); Gil-Garcia et al. (2015b) in their analysis of smart city domain, identify several works and six practical tools, where *smart government is seen as the source of smart public service delivery within a smart city*, *of city administration and of public engagement*, where public services can be classified in several typologies (Lee and Lee 2014); Scholl and Suha (2016), Scholl and Scholl (2014) and Scholl and Dwivedi (2014) view *smart government as smart city government, where city-wide ICT conduces smart service deliverable and where the local government implements policies for smart local development and stakeholders' engagement*; Gil-Garcia and Aldama-Nalda (2013) document *smart governance as the facilitator for local economy* via the efforts of local governments to adjust local regulatory frameworks for new business attraction and creation; Gil-Garcia et al. (2015b) consider that smart government in a smart city *uses and integrates ICT and innovation in the activities of governing, including internal operations, but also public services and citizen engagement*; Alawadhi et al. (2012) compare alternative definitions to justify the *need for better governance to manage smart city initiatives*. All these definitions are compared on (Table 6.1) and depicted on (Fig. 6.3), where bubble position

[7]Smart Cities Smart Government Research-Practice Consortium (https://www.ctg.albany.edu/projects/smartcitiesconsortium).

Table 6.1 Alternative smart government definitions

Term	Definition	Citation
Smart communities	Transform a geographical area in significant and fundamental ways with the ICT	Eger (1997)
Smart government	The extensive use of smart technology to perform governmental tasks	Mellouli et al. (2014), Cellary (2013)
	Interoperability/The implementation of a set of business processes and underlying ICT capabilities that enable seamless information flow across government agencies and programs, to become intuitive in providing high quality citizen services across all government programs and activity domains	Netten et al. (2016), Rubel (2014)
	Government's strategic role in society and the development of managerial capacities that enhances effectiveness (e.g., intra-governmental coordination, decentralization, increased participation, and renewal of organizational structures)	Kliksberg's (2000)
	Smart ICT government operations (e.g., cross-agency working groups for every ICT field; infrastructure for educational training; and instituting procurement strategies)	Key and We (2009)
	The evolution of the term 'smart government' to the term 'smart governance' in an attempt of governments to cope with complex and uncertain environments and to achieve resilience Set of smart government elements: *Openness and decision making, open information sharing and use, stakeholder participation and collaboration, and improving government operations and services, all through the use of intelligent technologies as they act as a facilitator of innovation, sustainability, competitiveness, and livability*	Scholl and Scholl (2014)
	A creative mix of emerging technologies and innovation in the public sector	Criado et al. (2013), Gil-Garcia et al. (2014), Puron-Cid (2014), Eom et al. (2016)

(continued)

Table 6.1 (continued)

Term	Definition	Citation
	Smart government is the next step for e-government	Jansen and Olnes (2016), Linders et al. (2015), Muhamedyev et al. (2015), Savoldelli et al. (2014), Hope (2001).
	Smart government is the next step for open government	Jun and Chung (2016), Jimenez et al. (2014a, b), Veljković et al. (2014)
Smart governance	Principles, factors, and capacities that constitute a form of governance able to cope with the conditions and exigencies of the knowledge society	Willke (2007)
	A dimension of smart city, which measures local smart government performance with the following indexes: participation in decision making; public and social services; transparent governance; and political strategies and perspectives	Recupero et al. (2016), Giffinger and Gudrun (2010)
	The facilitator for local economy via the effort of local governments to adjust local regulatory frameworks for new business attraction and creation	Gil-Garcia and Aldama-Nalda (2013), Gil-Garcia (2012)
	Better governance to manage smart city initiatives	Alawadhi et al. (2012)
Smart government and smart city	Smart city is an area of practice for smart government	Nam and Pardo (2014)
	Smart government is the source of smart public service delivery within a smart city, of city administration and of public engagement	Gil-Garcia et al. (2015a, b), Lee and Lee (2014)
	Smart city is an area for smart government development	Hu and Wang (2016), Hashem et al. (2016), Anthopoulos and Reddick (2015)
	Smart government deals with smart City government, which manages and implements policies by leveraging ICTs and institutions and by actively involving and collaborating with stakeholders	Scholl and Suha (2016), Scholl and Dwivedi (2014), Scholl and Scholl (2014)

represent the number of references and bubble size demonstrate the references relative ratio.

Since both smart government and smart governance terms are used in literature, a distinction must be given: “Government occurs when those with legally and formally derived authority and policing power execute and implement activities”

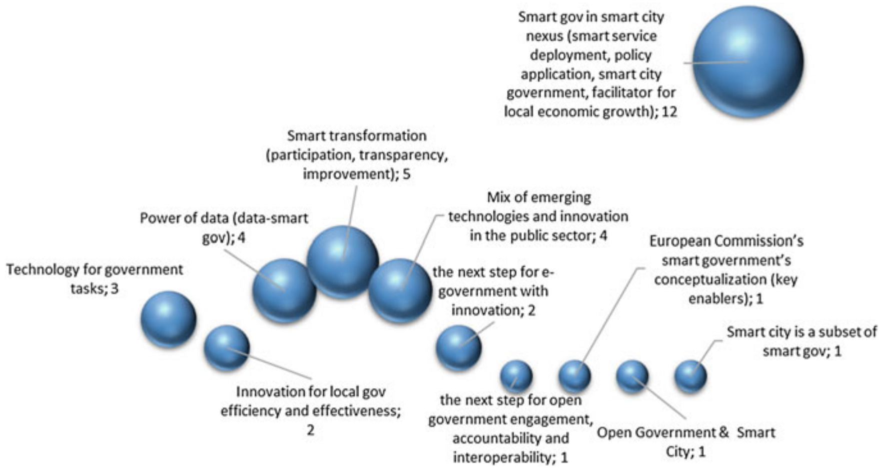


Fig. 6.3 The impact of the alternative smart government definitions

and "Governance refers to the creation, execution, and implementation of activities backed by the shared goals of citizens and organizations, who may or may not have formal authority or policing power (Bingham et al. 2005). Therefore, it is concluded that **smart governments implement smart governance initiatives** (Gil-Garcia et al. 2014). Finally, the definitions presented in Table 6.1 show that **smart government is not synonymous to smart city but, either the smart city is considered an area for smart government practice or smart government is a source for smart city development**.

The most important outcome is a unified framework that combines all the approaches that have been given by scholars in the identified literature. More specifically, (Fig. 6.4) shows that according to scholars, smart government can be considered as the evolution of both digital (e-)government and open government and of smart city at a local level (outer ring).

The second ring demonstrates corresponding subsets: first, digital (e-)government evolves mainly via smart services' and key-enablers' deployment (e.g., e-ID, procurement etc. like the ones defined by the European Commission) as well as via interoperability and result to an increased government effectiveness and efficiency. On the other hand, open government concerns openness with regard to its activities in service delivery, policy making (citizen engagement) and accountability with regard to its spending allocation and policy making process, all of which engage citizens. Finally, smart city has been analyzed in detail in the previous chapters with regard to its synthesis and can be easily concerned to address city government, while smart solutions enhance local economic growth and evidence-based policy making.

Finally, the internal ring depicts the three (3) basic components that drive the development of the second ring and in this respect smart government implementation: data (big and open) and emerging technologies (e.g., sensors, cloud etc.), accompanied by innovation in the public sector.

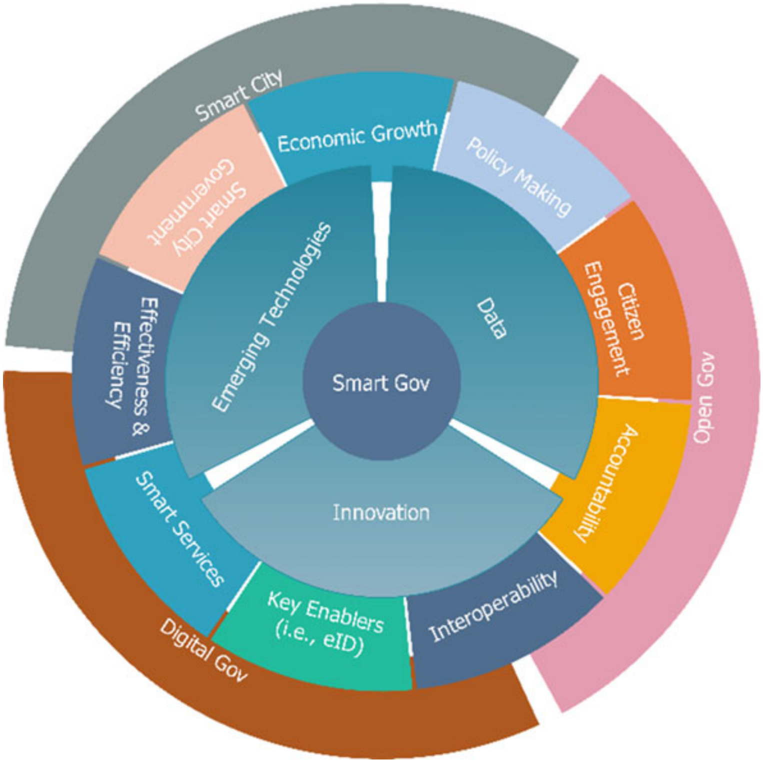


Fig. 6.4 A unified smart government framework

This framework can be compared with recent conceptual frameworks (e.g., given by Gil-Garcia et al. (2016) (Fig. 6.5). Such a conceptual framework emphasizes on smart government within a smart city and understands smart government as a nexus of 14 elements, all of which can be met in the suggested universal framework (Gil-Garcia et al. 2016):

1. *Government smartness and integration*, in terms of interoperability and information sharing.
2. *Government smartness and innovation*, in terms of new ideas and practices in the public sector.
3. *Government smartness and evidence-based decision making*, in terms of data utilization for decision justification.
4. *Government smartness and citizen centricity*, in terms of emphasizing on public value generation (what citizens and stakeholders desire).
5. *Government smartness and sustainability*, meaning an environmental friendly government that undertakes corresponding policy and planning.

Fig. 6.5 Smart government conceptual framework (Gil-Garcia et al. 2016)

6. *Government smartness and creativity*, which address human capital intelligence.
7. *Government smartness and effectiveness*, which concerns e-government benefits to an increasing public sector's performance.
8. *Government smartness and efficiency*, which emphasizes resource utilization and spending reduction.
9. *Government smartness and equality*, in terms of social equity establishment.
10. *Government smartness and entrepreneurialism*, in terms of policy contribution to new business and new job creation (e.g., data and climate change economy) and corresponding economic growth.
11. *Government smartness and citizen engagement*, which promotes accountability and public participation with information sharing, crowdsourcing and social networks.
12. *Government smartness and openness*, in terms of transparency and accountability.

Table 6.2 Comparing the unified with a conceptual framework

The unified smart government framework	Gil-Garcia et al. (2016) framework
1. Accountability	1. Openness
2. Smart services	2. Citizen centricity
3. Citizen engagement	3. Citizen engagement
4. Data	4. Evidence-based decision making
5. Economic growth	5. Entrepreneurialism
6. Effectiveness and efficiency	6. Effectiveness
	7. Efficiency
7. Emerging technologies	8. Technology savviness
8. Innovation	9. Innovation
9. Key-enablers	10. Creativity
10. Interoperability	11. Integration
11. Smart City Government	12. Sustainability
12. Policy making	13. Equality
	14. Resiliency

13. *Government smartness and resiliency*, in terms of contributing to city's resilience against emergencies with planning, information collection and sharing, collaboration and interoperability.
14. *Government smartness and technology savviness*, in terms of emerging technology utilization that minimize infrastructure demands (e.g., cloud, sensors and mobile services).

Beyond the fact that the resulted unified framework sees smart government beyond the smart city, the above 14 conceptual core elements can be located in a simplified manner of 12 core elements (from the second-level and the third-level rings) (Table 6.2).

Revision Question 1: what is smart government?
Revision Question 2: what is smart governance?
Revision Question 3: what is the smart government maturity model?
Revision Question 4: is smart government synonymous to smart city?
Revision Question 5: how can smart government be conceptualized at a broader and local level?
Revision Question 6: what are the core elements of smart government?
Revision Question 7: which can be considered the basic smart government drivers?

6.2 Smart Government in the Era of Global Urbanization and the Internet of Things

Something really seems to change with regard to government role. There's a shift from the century of nations to the century of cities, which has been documented in the document "Our Common Future" of the United Nations (United Nations 1987) and updated in 2014 (United Nations 2014). More specifically, the 21st century is recognized as the era of "urban evolution", since by the turn of the century almost half of the world lives in urban areas (from villages to megacities), a proportion that exceeds 50% in 2014 and it is expected to rise to an average 70% by 2050. Furthermore, the number of mega-cities has nearly tripled since 1990 and by 2030, 41 urban agglomerations are projected to house at least 10 million inhabitants each (United Nations 2014). This urbanization effect shows that some city governments are accountable to populations that are bigger than several nations, while they are obliged to play more important international role compared to many national governments.

Urbanization has been associated with economic and social transformations, with parallel effects (e.g., geographic mobility, lower fertility, longer life expectancy and population ageing etc.) (United Nations 2014). Moreover, the international economic system is an increasingly urban one that consists of overlapping networks of communications, production and trade. This system, with its flows of information, energy, capital, commerce, and people, provides the backbone for national development. Cities are important drivers of development and poverty reduction, as they attract much of the national economic activity, government and facilities, and provide crucial links with rural areas, between cities, and across international borders. Urban living is often associated with higher levels of literacy and education, better health, greater access to social services, and enhanced opportunities for cultural and political participation (United Nations 1987, 2014). As such, the role of city governments increases at a national level too.

The above two effects demonstrate an increasing city government role, which is not limited to national government decisions, but instead it has to undertake several initiatives in order to sustain against complex global challenges (e.g., climate change and economic growth with a reduced spending capacity) at a local level and to an increasing national and international competition, as Chaps. 2 and 4 of this book underline. On top of that, cities need to be able to integrate growing populations from different (ethnic, religious, socioeconomic) backgrounds (Meijer and Bolivar 2015).

However, city governments are not unarmed in front of this change, but they can utilize emerging technologies (e.g., data, sensors, cloud etc.) in order to enhance their strength. More specifically, local governments can sense with the Internet-of-Things (IoT) and monitor local conditions at a real-time with a minimum cost; can process and analyze this collected big data information easily; can enhance its proactive and responsive role with limited resources following the above analysis with planning; and can engage citizens with crowdsourcing, petition and deliberation tools in decision making processes, via broadly diffused mobile services. This ability to connect with its community provides the local government with an increasing citizen-centered role in terms of succeeding in citizen satisfaction.

On the other hand, the picture is not the same all over the world and mainly in the developing world, where only a few city governments have the power, resources, and trained staff to provide their rapidly growing populations with the land, services, and facilities needed for an adequate human life: clean water, sanitation, schools, and transport. In these cases, governments have first to deal with the crisis of mushrooming illegal settlements with primitive facilities, increased overcrowding, and rampant disease linked to an unhealthy environment (United Nations 1987).

Public opinion plays a vital role in the drive to improve living conditions in all the city types and governments have to live with it. For instance, even in industrial world cities, public pressure has triggered the abandonment of massive urban development projects and fostered residential schemes on a more human scale (United Nations 1987). Such effects obliged local governments to request changes in national urban strategies. For instance, the desire to limit the growth of existing cities has led to spatial policies designed to accelerate the development of secondary centers in an attempt to balance spatial development and secure national unity and political stability. However, these efforts have not proved to be successful since they are expensive and ineffective and instead they proceeded to centralized investments that encouraged major cities' growth (United Nations 1987).

Moreover, corresponding macroeconomic and pricing policies pursued by governments reinforced this concentration. The major cities—often the capital—usually receive a disproportionately large share of the total national expenditure for its facility provision (e.g., transportation, water etc.). In this respect, local governments try to increase—among the others—their role in gaining an increasing share from national government funding and smart city plays a crucial role in this purpose. However, city governments need to enhance their political, institutional, and financial capacity, notably access to more of the wealth generated in the city as a means to become key players for local growth. As a result, city governments have to leave back their neutrality or antagonism against local entrepreneurships and actively support new job development via program planning and partnerships (United Nations 1987).

Summarizing the above it is clearly understood that city government has an enhanced national and international role due to the urbanization era, while some city governments are accountable to larger communities compared to several national governments. This role's significance is based on the critical challenges that city governments have to deal with at a local level (e.g., climate change and economic growth etc.), while they also face usual urban challenges (e.g., living conditions and facilities upgrade). As such, smart government characteristics can contribute to this enhanced role with the identified creative mix of ICT and innovation, while smart city clearly comes to deal with urbanism. More specifically, data can enhance government proactive and open role, while emerging technologies can eliminate internal administrative boundaries and deliver whole of government services with the ability to focus on clear client needs.

Revision Question 1:	what are the characteristics of urbanism?
Revision Question 2:	why are local governments asked to play an advanced role in the urbanization era?
Revision Question 3:	name some urbanization challenges.
Revision Question 4:	how can smart government deal with urbanism?

6.3 Smart Government Evolution and Driving Forces

Governments were early adopters of technological change and ICT. Anthopoulos et al. (2015) mentioned that public sector's digitization and re-engineering was initially introduced during the decade of 1960s, while *Internet-enabled or e-government* followed in the early 1990s as a means to increase government effectiveness and efficiency. *Effectiveness* reflects perceptions of the quality of public services; the quality of civil service and the degree of its independence from political pressures; the quality of policy formulation and implementation; and the credibility of the government's commitment to such policies (Reddick and Anthopoulos 2014). On the other hand, *efficiency* concerns public sector's performance or productivity and it is mainly associated with public spending effects to socio-economic indicators (Reddick and Anthopoulos 2014).

Open government has been the next government change that focused on service and information transparency and public sector accountability. Government *transparency* generally occurs through one of four primary channels (Bertot et al. 2010):

1. proactive dissemination by the government;
2. release of requested materials by the government;
3. public meetings; and
4. Leaks from whistleblowers.

Moreover, government *accountability* is mainly seen as corresponding efforts against corruption and in this respect, as policies and means that (Bertot et al. 2012):

- make corruption risky and less attractive;
- enhance the use of public incentives to make public officials act responsibly and in the public interest;

– eliminate informational advantages to privileged groups;
– disable privileged control over resources;
– fight opportunism and enhance cooperation;
– promote the ability to select for honesty and efficiency in public sector positions and contract partners; and
– Strengthen social trust, and therefore development.

The next generation of government transformation has been labeled *Smart Government*, which was explained earlier as the combination of the characteristics of digital and open government, as well as smart city government, which is based on emerging technologies, data and innovation. Nam and Pardo (2014) partially measure smart government performance (Table 6.3) via focusing on its effectiveness, efficiency, collaboration and transparency, which comprise 2 forces—readiness and openness—that impact smart government development (Table 6.4).

On the other hand, Maheshwari and Janssen (2014) define the smart government ecosystem as "*a metaphor often used by policy makers, scholars, and technology gurus to convey a sense of the interdependent social systems of actors, organizations, material infrastructures, and symbolic resources that can be created in technology-enabled, information-intensive social systems*". Citizens and enterprises are in the center of this ecosystem, which is depicted as an inner-circle scheme (Fig. 6.6) and they access public services (first level circle) via alternative channels (e.g., web, social media, mobile networks etc.). The ecosystem proposed by (Maheshwari and Janssen 2014) has been extended with the incorporation of another inner circle layer, regarding stakeholders (e.g., smart city stakeholders). In this respect, public organizations (first level inner circle), stakeholders (second level

Table 6.3 Indexes for smart government measurement

	Management (internal view)	Service delivery (external view)
Efficiency	Internal managerial efficiency improvement – *Workloads, activities, and processes inside a public organization*	Service-oriented efficiency improvement – *Producing and delivering public services to citizens*
Effectiveness	Internal managerial effectiveness improvement – *Quality of internal management in government organizations*	Service-oriented effectiveness improvement – *The quality of services delivered to citizens by enhanced communications and interactions with them*
Transparency	Internal managerial transparency improvement – *Transparency in various processes through information sharing and integration across government organizations*	External transparency improvement – *Accessibility of information and decision processes related to service provision and delivery*
Collaboration	Internal collaboration – *Between agencies or departments inside government improvement*	External collaboration – *Between government and non-governmental parties*

Table 6.4 Forces that impact smart government development

	Strength	Explanation
1.	Organization readiness	Inter- and intra-organizational efficiency
2.	Points of interaction	Semantic definitions and classifications
3.	Code of interaction	Syntactic solicitation, translation and protocols for data linking
4.	Means for interaction	ICT, infrastructure and standards
5.	Data	Typical and big data
6.	Openness	Norms and tools that enable government information (data) transparency and accountability

inner circle) and private organizations (outer circle) collaborate for cost savings and performance enhancement during service provision. The dotted red line in (Fig. 6.6) demonstrate the execution of a potential scenario, where a citizen (user) applies for a service, for which alternative partners collaborate for its provision.

Indicatively, consider a citizen's application to the local water utility provider to recover a malfunction at his block, which demands the initiation of a construction project. According to the scenario, citizens could apply via the municipality website

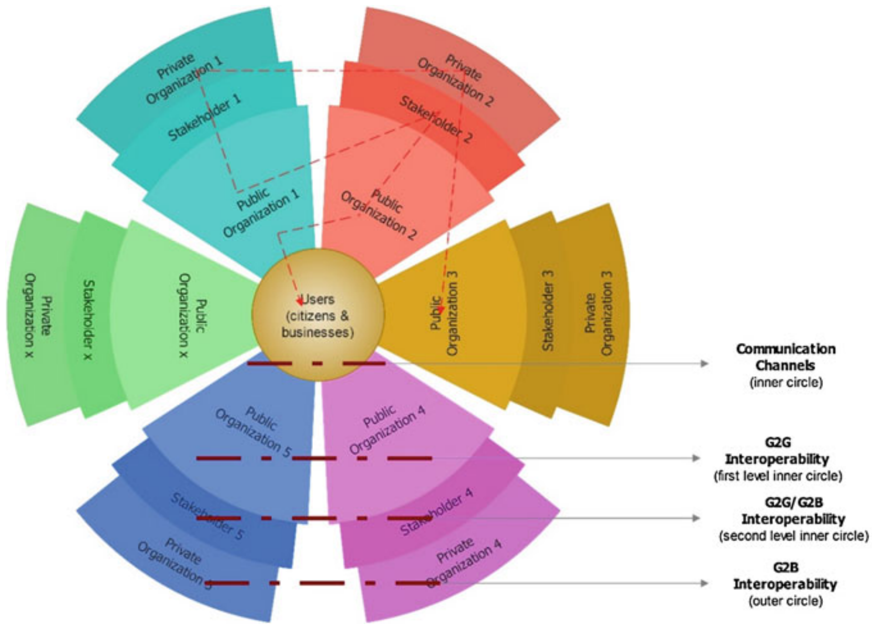


Fig. 6.6 Smart government ecosystem

(public organization 2), while the municipality would direct the application to the water utility provider (city stakeholder 2).

The provider, could require project permission by a second government layer state agency (public organization 1), while—after being authorized—the provider would assign project implementation to a contractor (private organization 1) or to multiple contractors (private organizations 1 and 2). Finally, contractors' payments would be granted by a budgetary authority (public organization 3) upon project completion. More or less complex scenarios can be performed within such an ecosystem, which require interoperability between the involved parties (Maheshwari and Janssen 2014). Organizational interoperability defines 3 more forces (points, code and means of interaction) that impact smart government development with the collaboration of alternative parties (Table 6.4), while data as a driving force cannot be ignored.

6.3.1 Data and Smart Government

As it was explained in chapter 3, data is the key for smartness (Cellary 2013) and the source for smart services, like the ones classified in typologies by Lee and Lee (2014). There are four sources of data that may feed smart services:

- *Data coming from sensors and devices*, e.g., cameras, deployed in the environment of people, e.g., homes, buildings, stations, streets, roads, etc., as well as coming from user oriented devices such as smart phones and wearable electronic devices;
- *Data provided by individuals* via social media and web/mobile applications;
- *Data collected by public authorities*;
- *Data collected by private companies*.

The literature review presented in Sect. 6.1 located—among others—an interrelation of smart government and data. More specifically, governments collect numerous data, including demographic, property ownerships, crime, business, intelligence or traffic data at the least (Choi et al. 2014). The need of sharing these data between government organizations is extreme, because data can be more meaningful when integrated and shared. For example, police require tax payment information of a person or a business entity, while national tax agency should collect border entry data for immigration office or airport authority. In this respect, a question is generated regarding the types of data that can structure the context of this fundamental force.

Open data are instrumental in the transformation from e-government to smart government (Harsh and Ichalkaranje 2015). Open data was defined in Sect. 6.3 and concern *data that meets the criteria of being accessible at no more than the cost of reproduction, without limitations based on user identity or intent, in a digital format and free of restriction on use or redistribution in its licensing conditions* (Nubroho et al. 2015). Open data have several social and economic impacts: in

EU27 alone, open data contributed with €32 billion the European economy and with an estimated annual growth rate 7%. Most developed countries have drafter corresponding open data policies [e.g., United States[8] (US) that was launched in 2010; United Kingdom (UK)[9] with approximately 17,837 datasets; Australia[10] with 3362 datasets; The Netherlands[11] without a national-level open data policy but with clear guidelines on publishing government data etc.]. The overall open data development process that a government must undertake contains measures in the following areas:

1. *Community engagement* in order to dynamically collect citizen needs.
2. *Financial investment* from both government and private sector regarding open data production and utilization.
3. *Automation* regarding datasets continuous production, update and maintenance.
4. *Collaboration* between agencies located at all levels of government.
5. *Governance* of the overall process.

Nugroho et al. (2015) compared several open data national policies and concluded on a framework for open data policy development. This framework (Table 6.5) shows that a policy has a *context* (e.g., locality, motivations, economic context, legislation etc.), a *content* (describing open data) and an *impact* that represents the produced public value (e.g., use, risks and benefits). This framework generates requirements for corresponding legislature alignments; open data use encouragement; and data quality insurance.

Beyond open data and government discussion, an extending dialogue occurs regarding **big data** and government. Big data are increasingly measured in Terabytes and can be defined as (Bertot and Choi 2012):

- Vast datasets that cannot be analyzed using conventional software;
- Require significant processing power (such as via a supercomputer);
- Span a range of data types such as text, numeric, image, video; and
- Can cross multiple data platforms such as from social media networks, web log files, sensors, location data from smart phones, digitized documents, and photograph and video archives.

The dialogue about big data and government started back in 1970, when Alvin Toffler coined the phrase "information overload", an issue that can be recently treated with the ability to harness large-scale datasets and transform them to instruments for scientific and economic growth (Bertot and Choi 2012):

[8] http://data.gov for open data and http://recovery.gov for accountability.

[9] http://data.gov.uk.

[10] http://data.gov.au.

[11] http://data.overheid.nl.

Table 6.5 Framework for open data development policy (Nugroho et al. 2015)

Element category	Element	
Policy context	Level of government organization	
	Key motivations, policy objectives	
	Open data platform launch	
	Resource allocation and economic context	Technology penetration
		ICT infrastructure
		Source of funding
	Legislation	
	Social and political contexts	Political constituencies
		Individualism and collectivism
		Exclusionism and universalism
		Particularism and universalism
		Cultural beliefs
	Data opening drivers	Event based
		Various forces
	Data opening barriers	
Policy content	Technical aspects of the open data process	Licensing
		Fees for access
		Data presentation
		Restricted data
		Contact with data users
		Amount of published data
		Processing of data before publishing
		Opening costs
	Technical aspects of the data	Types of data
		Data format and standards
		Data quality
		Provision of metadata
		Interoperability with other data
		Accessibility of data
		Encouragement for data re-use
Policy impact	Data re-use	
	Predicted risks	
	Benefit alignment with motivation	
	Public values	

1. **Drivers for economic competitiveness**, since they create new markets and increase productivity;
2. **Significant contribution to national and economic challenges** (e.g., energy, transportation, education and training, healthcare, safety and security);

3. **Sources to open new horizons in almost all scientific fields** (e.g., they supported the illumination of Alzheimer's disease progression, the prediction of ozone hole's size etc.);
4. **Essential to achieving open government's targets** (e.g., with the provision of accessibility to almost all government records and the enhancement of public feedback realization etc.).

Big data (Bertot and Choi 2012) bring significant promises regarding traffic management, climate change prediction and energy consumption decrease, but these benefits come with a number of challenges too, concerning data **philosophy** with regard to their openness principles for transparency, participation and collaboration; **policies** with regard to ownership, privacy, security, accuracy and archiving; **authority**, **quality**[12] and **governance**; **platform**, **quantity** and **formatting**; **curation**, **preservation** and **availability**; **use** and **reuse**; and **communities**[13] and **research collaboration**.[14] All these pros and cons require major data policy-making to be performed by governments, not only in developed but in developing countries too, which exceed big data production and dissemination by open data portals. All the above Big Data challenges generated discussions and schools for thought (like the US National Science Foundation), which have returned various recommendations (Bertot and Choi 2012) concerning a demand for a continuous monitoring and assessment on all of them.

Revision Question 1: how is data related with government?
Revision Question 2: what is the primary element that smart government can deliver for data?

6.3.2 Connecting People, Process, Data and Things

This label "People, Process, Data and Things" is so-called Internet-of-Everything (IoE) and represents an ecosystem whereby each human on average is currently

[12]Like the Dublin Core metadata element set (http://dublincore.org) and ISO19115 for geospatial metadata.

[13]http://www.data.gov/communities/ like the following:

- BusinessUSA (http://www.data.gov/communities/business),
- Cities (http://www.data.gov/communities/cities),
- Education (http://www.data.gov/communities/education) and
- Health (http://www.data.gov/communities/health).

[14]Like the Big Data Research and Development Initiative (http://www.whitehouse.gov/sites/default/files/microsites/ostp/big_data_press_release_final_2.pdf) and the Digging Into Data (http://www.diggingintodata.org).

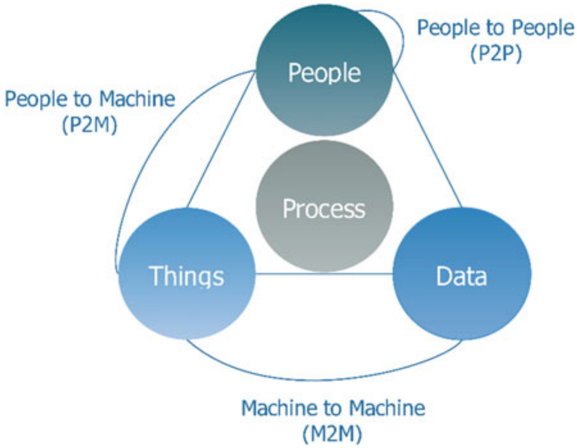


Fig. 6.7 Internet of everything (CISCO 2013)

connected to about 200 things (smart phones, tablets, sensors and systems) (Rampersad 2014). IoE has been defined from this viewpoint as *the technology that brings together people, process, data, and things to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries* (Schatten et al. 2016). "Everything" implies whatever already exists, whatever is already known, whatever "is" according to business interests and mainly concerns big data exchange and analysis (Bojanova et al. 2014). This definition extends the IoT with an interconnection of the several machines with people and processes (Fig. 6.7), each of which represents the following (CISCO 2013; Clarke 2013; Bojanova et al. 2014):

1. *People*: people connect to the Internet with many devices (e.g., PCs, tablets, TVs, and smartphones) to access several social networks (e.g., Facebook, Twitter and LinkedIn etc.). In the IoE ecosystem, this connection extends to several various ways (e.g., with a pill that senses and reports the health of their digestive tract to a doctor). As such, people will become nodes on the Internet, with both static information and a constantly emitting activity system.
2. *Data*: devices typically collect and transmit data in IoT as it was presented in Chap. 3 (M2M integration). In the IoE ecosystems data is transformed to information, since the connected things submit higher-level information to other machines and to people, for further evaluation and decision-making. This transformation will enable faster, more intelligent decisions, as well as control our environment more effectively.
3. *Things*: physical items (e.g., sensors, devices and enterprise assets etc.) are interconnected in IoT, but the same devices in the IoE ecosystem will sense more data, become context-aware, and provide more experiential information to help people and machines make more relevant and valuable decisions.

4. *Process*: represents the method with which the above entities (people, data and things) work together to deliver value in the IoE. With the correct process the right information will be delivered to the right destination (people or machine) at the right time.

IoE multilayer technical architectures can be realized in cities, aggregating sensors, data storage and analytics, and applications. Such an architecture requires the integration of sensors via a deployed network around a given application (e.g., streetlight management, video surveillance, or environmental monitoring etc.). While separate networks provide a natural separation of domains, typically they are not optimized (costs, security, availability), generating information silos. In addition, interaction between the sensor and devices in each network requires specific integration. In this respect, horizontal multiservice infrastructure can host all the individual systems, handle millions of devices and sensors; thousands of servers; multidimensional transmission, processing, and streaming of Big Data; and more (CISCO 2013). In general, an architecture framework for the IoE has to follow the same principles like smart city's architecture, which were presented in Sect. 6.2 of this book.

Governments have started estimating the values that can gain from the IoE in similar to the private sector ways (e.g., reports in 2013 demonstrate that the capacity of the IoE can deliver $14.4 US trillion net profits by 2022) (CISCO 2013). The public sector realizes value from different lens and focuses on efficiency, effectiveness, accountability and citizen centricity according to the outcomes from the above Sect. 6.1. As such, at a local level, city governments can improve building management, enhance traffic flow, develop cutting-edge smart services (e.g., street lighting as a service), water or waste management, and policing. Similarly, national governments can utilize IoE in areas like highway traffic management, healthcare, education and agriculture etc. (CISCO 2013).

Moreover, IoE can enable new operating models for governments and mainly for city governments. For instance, "pay per use" against to "pay to see" solutions can be applied in several smart city schemas (e.g., for parking space use) and can break down typical centralized management system and isolated service functions and departments. Moreover, from a procurement side, city governments are starting to move from a centralized, products-and-services procurement model to a "decision as a service" model (CISCO 2013).

Revision Question 1: how does the IoE extends the IoT?
Revision Question 2: what the role of the process element in the IoE?
Revision Question 3: how can governments utilize the IoE?
Revision Question 3: how can a smart city utilize the IoE?

6.3.3 *Co-produce with Citizens*

Co-production of public services as a theoretical concept goes back in the 1980s and has been associated with government transformation, and with citizen-centricity and public sector innovation (Linders 2012). Co-production stands for '*the provision of services through regular, long-term relationships between professionalized service providers (in any sector) and service users or other members of the community, where all parties make substantial resource contributions*' (Castelnovo 2015). However, it is quite ambiguous what the "product" as well as the analytic que of steps of this co-production process is.

Co-production is a value-creating activity that respects the role of the users/consumers. Actually, co-production is much more than user/consumer involvement. In the private sector, the firm (provider) usually is in charge of the overall orchestration and consumers play a more passive role in the process, while the managers pass a part of the work that is usually done by the firm to their customers (Castelnovo 2015). However, co-production must activate the users in the (co) creation of value.

In the public sector, value has been seen as environmental sustainability, social inclusion or the spreading of benefits across the widest possible range of local community members. In this respect, users may want to play a more active role in service co-production and their contribution generates the so-called *public value*. Public value is the fundamental value created through the citizens' involvement as co-producers in the value creation process, which does not exclude that co-producers could get also a private value from their participation in the value creation process (Castelnovo 2015).

The service's value co-production process can follow different forms considering how the responsibility for service planning and service delivery is distributed between civil servants (professionals) and citizens: (a) uniquely by professionals; (b) uniquely by citizens; and shared between servants and citizens (Table 6.6). The path from

Table 6.6 Roles in service co-production (Castelnovo 2015)

		Responsibility for public service design		
		Public servant	Servants & citizens	Citizens
Responsibility for public service delivery	Public servant	1. Traditional service provision	2. Mixed (co-production on the design side)	3. Public servant as sole deliverer
	Servants & citizens	4. Mixed (co-production on the delivery side)	5. Full co-production	6. Mixed (co-production on the delivery side)
	Citizens	7. Citizens' delivery of a professionally designed service	8. Mixed (co-production on the design side)	9. Self-organized citizens' provision

Table 6.7 Variables that influence co-production (Linders 2012)

(A) Defining the spectrum of the government-citizen relationship	(B) Defining the spectrum of public service delivery partnerships
Actor versus beneficiary: What is the division of labor—who is leveraging whom?	Stage of service delivery cycle: At which phase of the service/policy cycle is the activity occurring?
Citizen power and responsibility: How much control do citizens have vis-à-vis the government?	Problem versus opportunity driven: Is the effort defensive or offensive in nature?
Embeddedness: To what degree is government staff embedded within the community and its processes?	Single-purpose versus broad: How focused is the initiative?

configuration 1 through configuration 5 (full co-production) to configuration 9 re-defines the power relationships between professionals and citizens (Castelnovo 2015), while the variables that influence co-production are depicted on (Table 6.7).

The types of co-production range as follows (Linders 2012):

(A) "**Citizen-Sourcing**" (**Citizen-to-Government**)

1. *Service Design*: *Consultation and Ideation*—Deliberation tools are used to open dialogue with citizens.
2. *Service Delivery and Execution*: *Crowdsourcing and Co-Delivery*—new problem-solving mechanism that invites everyday citizens to use their skills and expertise to solve government challenges.
3. *Service Monitoring*: *Citizen Reporting*—Citizens the ability to report things like potholes and crime using their mobile phones.

(B) "**Government as a Platform**" (**Government to Citizen**)

1. *Service Design*: *Informing & Nudging*—Highly personalized information is delivered by governments to help inform citizens' personal decisions (e.g., Government data mining could notify users of relevant health risks).
2. *Service Delivery and Execution*: *Ecosystem Embedding*—Open existing government resources for social use.
3. *Service Monitoring*: *Open Book Government*—Citizens have access to open data and can evaluate government performance.

(C) "**Do It Yourself Government**" (**Citizen to Citizen**)

1. *Service Design*: *Self-Organization*—Social media and online collaboration platforms enable communities to more easily and effectively self-organize.
2. *Service Execution and Delivery*: *Self-Service*—Social media and online collaboration platforms offer new channels for coordinating community-based collective action and replace government as the intermediary by facilitating direct citizen to citizen assistance.
3. *Service Monitoring*: *Self-Monitoring*—Feedback mechanisms for measuring service performance.

Chapter 3 shows that citizens can become sensors in smart cities, providing different types of information that can be used to implement user-contribution-based services, while citizens can contribute (crow-sourcing) the fundamentals for service provision (the information). Citizens can be conscious or unconscious sensors in this process of user-generated data.

Some examples of user-generated services were presented during the demonstration of the examined smart cities and concern for instance the Fix My Street.[15] Moreover, some more well-known cases concern the Patients Like Me[16]; Connexions[17]; Wiki Crimes[18]; Farmsubsidy[19]; Seniorweb[20]; Social street[21] and Neighborhood watch.[22] All these services have been developed by non-public sector organizations; nevertheless, they deliver a public value in terms of better city management and maintenance; increased public health, safety and security; support to life-long learning; enabling the creation and the strengthening of local communities; reducing the risk of exclusion (Castelnovo 2015). Giving back power to citizens, not only in the decision-making processes presented in the following sub-section, but also in the implementation and delivery of services, is thus the condition that enables citizens to contribute with their smartness the smart city development, acting as public service's co-producers.

6.3.4 *Co-decide with Citizens*

The Internet and the ICT have enabled citizens with the potential to reduce the gap—or even to connect—with the political elites and influence policy making, especially today that traditional political participation is in decline (Bruno 2015). This co-decision process can be performed with crowdsourcing (e.g., co-legislating), petitions and social media. Such a process has been enabled with the use of alternative crowd-sourcing tools (so-called smart management or participatory democracy tools[23]) and has been followed by the European Parliament in forming its political documentation (Bruno 2015). The adopted process contains 4 steps (sub-processes), starting from open consultation; collection of inputs; draft

[15]FixMyStreet.com.

[16]PatientsLikeMe.com.

[17]cnx.org.

[18]WikiCrimes.org.

[19]Farmsubsidy.org.

[20]seniorweb.nl.

[21]socialstreet.it.

[22]http://www.nnwi.org/.

[23]http://www.governing.com/columns/smart-mgmt/col-participatory-democracy-emerging-tools.html.

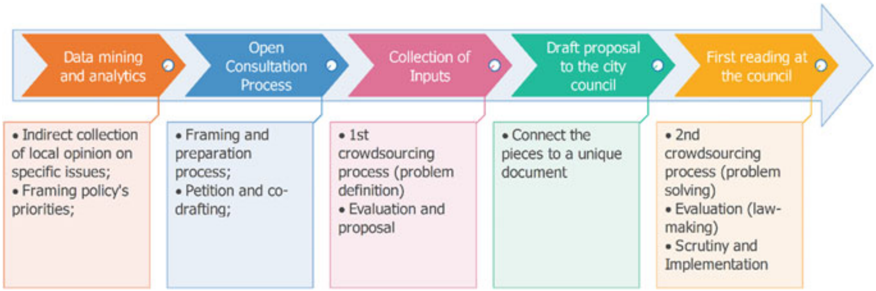


Fig. 6.8 A co-decide process in smart city

proposal and communication to the European Parliament and Council; and first reading in the European Parliament.

Local governments can enable similar participatory democracy methods with the use of smart infrastructure and services. Such a process (Fig. 6.8) has been inspired by (Bruno 2015), it would enhance citizens' interest in local policy making and increase social trust and government's transparency. A first step has been introduced due to the smart city potential in performing data mining in several local sources that could generate a list of thoughts regarding how citizens recognize a specific problem. This input could frame corresponding political priorities, which will be introduced to the crowd (step 2) and proceed with petition and co-drafting methods.

Then, a full crowdsourcing method with citizen's direct contribution will result to a clear problem's definition (step 3), which can form a political document (step 4) to be discussed at the city council. First reading (step 5) will be accompanied by a second crowdsourcing process—where the community's representatives will contribute with their feedbacks-, evaluation, detailed analysis and implementation.

Revision Question 1: what does "co-decide with citizens" mean?
Revision Question 2: how can a community co-decide with the city council?

6.4 Conclusions

This chapter analyzed the context of smart government. It performed a literature review on the term, where several conceptualization models appeared, compared and explained. It is cleared that *smart government* is different to *smart city government* and to *smart city*. On the contrary, smart city can be seen as an area of practice for smart government, while smart governance is one of the smart city's dimensions.

Moreover, the role of government is documented to be changed due to urbanization and technology. Urbanization results to communities, which are larger to nations and the role of local government is more complex compared to the usual national one. Moreover, technology provides governments with tools that has never got before, like the Internet-of-Things (IoT), which changes information collection and process flow, while it enables a direct and continuous connection with the community. Both these two phenomena highlight the government challenges of the forthcoming decades, which governments try to deal with data, process re-engineering, co-decision and service co-production.

References

Alawadhi, S., Aldama-Nalda, A., Chourabi, H., Gil-Garcia, J. R., Leung, S., Mellouli, S., et al. (2012). Building understanding of smart city initiatives. In H. J. Scholl, M. Janssen, M. A. Wimmer, C. E. Moe, & L. S. Flak (Eds.), *Electronic government, LNCS* (Vol. 7443, pp. 40–53). London, New York: Springer.

Anthopoulos, L., & Reddick, C. G. (2015). Understanding electronic government research and smart city. *Information Polity* (in press). doi:10.3233/IP-150371

Anthopoulos, L., & Reddick, C. G. (2016). Smart city and smart government: Synonymous or complementary? In *Proceedings of the WWW2016 ACM 25th World Wide Web International Conference*, Montreal, Canada. doi:10.1145/2872518.2888615

Anthopoulos, L., Reddick, C. G., Mavridis, N., & Giannakidou, I. (2015). Why e-government projects fail? An analysis of the healthcare.gov website. *Government Information Quarterly* (in press). doi:10.1016/j.giq.2015.07.003

Bertot, J. C., & Choi, H. (2012). *Big Data: Strategies, Issues, & Recommendations*. Retrieved December 30, 2015, from http://ipac.umd.edu/sites/default/files/publications/BigDataReport07November2012.pdf

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2012). Promoting transparency and accountability through ICTs, social media, and collaborative e-government. *Transforming Government: People, Process and Policy, 6*(1), 78–91.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly, 27,* 264–271.

Bingham, L. B., Nabatchi, T., & O'Leary, R. (2005). The new governance: Practices and processes for stakeholder and citizen participation in the work of government. *Public Administration Review*, *65*(5), 547–558.

Bojanova, I., Hurlburt, G., & Voas, J. (2014). Imagineering an internet of anything. *IEEE Computer, 47*(6), 72–77.

Bruno, E. (2015). Co-deciding with citizens: Towards digital democracy at EU level. Retrieved September, 2016, from http://www.ecas.org/wp-content/uploads/2015/06/ECAS-Publication-online-version.pdf

Castelnovo, W. (2015). Citizens as sensors/information providers in the coproduction of smart city services. In *Proceedings of the 12th Annual Conference of the Italian Chapter of AIS* (*ITAIS*). Rome, Italy.

Cellary, W. (2013). Smart governance for smart industries. In *Proceedings of the 7th International Conference on Theory and Practice of Electronic Governance (ICEGOV '13*). Oct 22–25, 2013, Seoul, Republic of Korea, pp. 91–93.

Clarke, R. Y. (2013). *Smart cities and the internet of everything: The foundation for delivering next-generation citizen services*. IDC Government Insights: Whitepaper.

CISCO. (2013). The internet of everything for cities: Connecting people, process, data, and things to improve the 'livability' of cities and communities. Retrieved September, 2016, from http://www.cisco.com/c/dam/en_us/solutions/industries/docs/gov/everything-for-cities.pdf

Choi, J., Chun, S. A., & Cho, J-W (2014). Smart secure gov: Mobile government security framework. In *Proceedings of the 15th Annual International Conference on Digital Government Research (dg.o)*, pp. 91–99.

Cook, M. E., Gil-Garcia, J. R., & Zheng, L. (2016). The smart cities and smart government research practice (SCSGRP) consortium workshop. In *Proceedings of the 17th International Digital Government Research Conference on Digital Government Research (dg.o'16).* Shanghai, China.

Cornadie, P., & Choenni, S. (2014). On the barriers for local government releasing open data. *Government Information Quarterly, 31,* S10–S17.

Criado, J. I., Sandoval-Almazan, R., & Gil-Garcia, J. R. (2013). Government innovation through social media. *Government Information Quarterly, 30,* 319–326.

Dai, X. (2003). A new mode of governance? Transnationalization of European regions and cities in the information age. *Telematics and Informatics, 20,* 193–213.

Eger, J. (1997). Cyberspace and cybersplace: Building the smart communities of tomorrow. *San Diego Union-Tribune* (online). Retrieved November 5, 2015, from http://www.smartcommunities.org/pub_cyberplace.htm

Eom, S.-J., Choi, N., & Sung, W. (2016). The use of smart work in government: Empirical analysis of Korean experiences. *Government Information Quarterly*. doi:10.1016/j.giq.2016.01.005. (in press).

European Commission. (2012). eGovernment benchmark framework 2012–2015. Brussels: European Commission DG communications networks, content and technology method paper no. SMART 2012/0034-1. Retrieved September, 2016, from https://ec.europa.eu/futurium/en/system/files/ged/egovernment_benchmarking_method_paper_published_version_0.pdf

Giffinger, R., & Gudrun, H. (2010). Smart cities ranking: An effective instrument for the positioning of cities? *ACE: Architecture, City and Environment, 4*(12), 7–25.

Gil-Garcia, J. R., Zhang, J., & Puron-Cid, G. (2016). Conceptualizing smartness in government: An integrative and multi-dimensional view. *Government Information Quarterly*. doi:10.1016/j.giq.2016.03.002. forthcoming.

Gil-Garcia, J. R., & Sayogo, D. S. (2016). Government inter-organizational information sharing initiatives: Understanding the main determinants of success. *Government Information Quarterly*. doi:10.1016/j.giq.2016.01.006. (in press).

Gil-Garcia, J. R., Pardo, T. A., & Nam, T. (2015a). What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization. *Information Polity, 20*(1), 61–87.

Gil-Garcia, J. R., Pardo, T. A., & Nam, T. (2015b). Comprehensive view of the 21st century city: Smartness as technologies and innovation in urban contexts. In J. R. Gil-Garcia et al. (Eds.), *Smarter as the New Urban Agenda*, Public Administration and Information Technology Series (11) (pp. 1–19). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-17620-8_1

Gil-Garcia, J. R., Helbig, N., & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government Information Quarterly, 31*(S1), I1–I8.

Gil-Garcia, J. R. (2013). Towards a smart state? Inter-agency collaboration, information integration, and beyond. In A. J. Meijer, F. Bannister, & M. Thaens (Eds.), *ICT, public*

administration and democracy in the coming decade, innovation and the public sector series, 20 (pp. 59–70). Amsterdam: IOS Press BV.
Gil-Garcia, J. R., Pardo, T. A., & Aldama-Nalda, A. (2013). Smart cities and smart governments: Using information technologies to address urban challenges. In *Proceedings of the 14th Annual International Conference on Digital Government Research* (*dg.o*), pp. 296–297.
Gil-Garcia, J. R., & Aldama-Nalda, A. (2013). Smart city initiatives and the policy context: The case of the rapid business opening office in Mexico city. In *Proceedings of the 14th Annual International Conference on Digital Government Research* (*dg.o*), pp. 234–237.
Gil-Garcia, J. R. (2012). Towards a smart state? Inter-agency collaboration, information integration, and beyond. *Information Polity, 17*(3, 4), 269–280.
Harsh, A., & Ichalkaranje, N. (2015). Transforming e-government to smart government: A South Australian perspective. *Advances in Intelligent Systems and Computing, 1,* 9–16.
Hashem, I. A. T., Chang, V., Anuar, N. B., Adewole, K., Yaqoob, I., Gani, A., et al. (2016). The role of big data in smart city. *International Journal of Information Management, 36*(5), 748–758.
Hope, K. R. (2001). The new public management: Context and practice in Africa. *International Public Management Journal, 4,* 119–134.
Hu, Y., & Wang, J. (2016). Building smart government or developing industry? Study on the designs of local smart city pilot projects in China. In *Proceedings of the 17th International Digital Government Research Conference on Digital Government Research* (*dg.o'16*). Shanghai, China.
Jansen, A., & Olnes, S. (2016). The nature of public e-services and their quality dimensions. *Government Information Quarterly* (in press). doi:10.1016/j.giq.2016.08.005
Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly, 32,* 221–236.
Jetzek, T. (2016). Managing complexity across multiple dimensions of liquid open data: The case of the Danish basic data program. *Government Information Quarterly, 33,* 89–104.
Jiménez, C. E., Solanas, A., & Falcone, F. (2014a). E-government interoperability: Linking open and smart government. *Computer, 47*(10), 22–24.
Jiménez, C. E., Falcone, F., Solanas, A., Puyosa, H., Zoughbi, S., & González, F. (2014b). Smart government: Opportunities and challenges in smart cities development. In Ć. Dolićanin, E. Kajan, D. Randjelović, & B. Stojanović (Eds.), *Handbook of research on democratic strategies and citizen-centered e government services* (pp. 1–19). Hershey, PA: IGI Global.
Jun, C. N., & Chung, C. J. (2016). Big data analysis of local government 3.0: Focusing on Gyeongsangbuk-do in Korea. *Technological Forecasting and Social Change, 110,* 3–12.
Kliksberg, B. (2000). Rebuilding the state for social development: Towards "smart government". *International Review of Administrative Sciences, 66*(2), 241–257. doi:10.1177/0020852300662002.
Lee, J., & Lee, H. (2014). Developing and validating a citizen-centric typology for smart city services. *Government Information Quarterly, 31,* S93–S105.
Linders, D., Liao, C. Z.-P., & Wang, C.-M. (2015). Proactive e-Governance: Flipping the service delivery model from pull to push in Taiwan. *Government Information Quarterly*. doi:10.1016/j.giq.2015.08.004 (in press).
Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly, 29,* 446–454.
Luna-Reyes, L. F., & Pardo, T. A. (2015). The smart cities and smart government research-practice (SCSGRP) consortium. In *Proceedings of the 16th Annual International Conference on Digital Government Research* (*dg.o'15*). Phoenix, USA.
Maheshwari, D., & Janssen, M. (2014). Reconceptualizing measuring, benchmarking for improving interoperability in smart ecosystems: The effect of ubiquitous data and crowdsourcing. *Government Information Quarterly, 31,* S84–S92.
Meijer, A., & Bolivar, M. P. R. (2015). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences, 0*(0), 1–17.

Mellouli, S., Luna-Reyes, L. F., & Zhang, J. (2014). Smart government, citizen participation and open data. *Information Polity, 19,* 1–4.

Muhamedyev, R. I., Ishmanov, A., Andreev, A. V., Alikhodzhayev, I., & Muhamedijeva, J. (2015). Technological preconditions of monitoring of renewable energy sources of the Republic of Kazakhstan. In *Proceedings of the 2015 12th International Conference on Electronics Computer and Computation* (*ICECCO*). Almaty, Kazakhstan.

Nam, T., & Pardo, T. A. (2014). The changing face of a city government: A case study of Philly311. *Government Information Quarterly, 31,* S1–S9.

Netten, N., Bargh, M. S., van den Braak, S., Choenni, S., & Leeuw, F. (2016). On enabling smart government: A legal logistics framework for future criminal justice systems. In *Proceedings of the 17th International Digital Government Research Conference on Digital Government Research (dg.o'16).* Shanghai, China.

Nugroho, R. P., Zuiderwijk, A., Janssen, M., & de Jong, M. (2015). A comparison of national open data policies: Lessons learned. *Transforming Government: People, Process and Policy, 9*(3), 286–308.

Paulin, A., Anthopoulos, L., & Adewale, A. (2016). Beyond bureaucracy versus smart government (BBSG 2016): Towards the ecosystem. In *Proceedings of the 17th International Digital Government Research Conference on Digital Government Research* (*dg.o'16*). Shanghai, China.

Puron-Cid, G. (2014). Factors for a successful adoption of budgetary transparency innovations: A questionnaire report of an open government initiative in Mexico. *Government Information Quarterly, 31,* S49–S62.

Rampersad, G. (2014). The internet of everything: Assessing its impact on business and community. In G. Rampersad, & F. Patel (Eds.), *Technology innovation leadership in development: A 'Middle East' (West Asia) Perspective*, Nova Science Publishers, Inc., pp. 117–132.

Recupero, R., Castronovo, M., Consoli, S., Costanzo, T., Gangemi, A., Grasso, L., et al. (2016). An innovative, open, interoperable citizen engagement cloud platform for smart government and users' interaction. *Journal of Knowledge Economy, 7*(2), 388–412.

Reddick, Ch., & Anthopoulos, L. (2014). Interactions with e-government, new digital media, and traditional channel choices: Citizen-Initiated factors. *Transforming Government: People, Process and Policy, 8*(3), 398–419.

Rubel, T. (2014). *Smart government: Creating more effective information and services* (online). Retrieved November 5, 2015, from http://www.govdelivery.com/pdfs/IDC_govt_insights_Thom_Rubel.pdf

Ryan, J., McClure, C. R., & Wigand, R. T. (1994). Federal information resources management: New challenges for the nineties. *Government Information Quarterly, 11*(3), 301–314.

Savoldelli, A., Codagnone, C., & Misuraca, G. (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. *Government Information Quarterly, 31,* S63–S71.

Schatten, M., Ševab, J., & Tomicic, I. (2016). A roadmap for scalable agent organizations in the internet of everything. *The Journal of Systems and Software, 115,* 31–41.

Scholl, H. J., & Suha, A. (2016). Creating smart governance: The key to radical ICT overhaul at the City of Munich. *Information Polity, 21*(1), 21–42.

Scholl, H. J., & Al Awadhi, S. (2015). Pooling and leveraging scarce resources: The smart eCity gov alliance. In *Proceedings of the Annual Hawaii International Conference on System Sciences* (*HICSS*), pp. 2355–2365.

Scholl, H. J., & Dwivedi, Y. K. (2014). Forums for electronic government scholars: Insights from a 2012/2013 study. *Government Information Quarterly, 31,* 229–242.

Scholl, H. J., Scholl, M. C. (2014). Smart governance: A roadmap for research and practice. In *Proceedings of the iConference 2014*, pp. 163–176.

Taylor, J. A. (2015). The art of the possible: Innovation, smart government and the enduring braking-power of traditional public administration. *Information Polity, 20,* 1–2.

Turle, M. (2010). Shared services: An outline of key contractual issues. *Computer Law & Security Review, 26,* 178–184.

United Nations. (1987). *Report of the World Commission on Environment and Development: Our Common Future*. Retrieved September, 2016, from http://www.un-documents.net/our-common-future.pdf

United Nations. (2014). *World Urbanization Prospects—Highlights*. Retrieved September, 2016, from https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf

Veljković, N., Bogdanović-Dinić, S., & Stoimenov, L. (2014). Benchmarking open government: An open data perspective. *Government Information Quarterly, 31,* 278–290.

Willke, H. (2007). *Smart governance: Governing the global knowledge society*. Frankfurt: Campus Verlag.