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Comparative Study of Smart Cities in Europe and China 2014

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China Academy of Information and Communications Technology • EU-China Policy Dialogues Support Facility II

Comparative Study of Smart Cities in Europe and China 2014

Supported by
Ministry of Industry and Information Technology (MIIT)
DG CNECT, EU Commission

Drafted by
China Academy of Information and Communications Technology (CAICT)
EU-China Policy Dialogues Support Facility II (PDSF)

August 2014

SINCE 1897 商務印書館 The Commercial Press

Springer

China Academy of Information
and Communications Technology
Beijing, China

EU-China Policy Dialogues
Support Facility II
Beijing, China

ISSN 2194-7937 ISSN 2194-7945 (electronic)
Current Chinese Economic Report Series
ISBN 978-3-662-46866-1 ISBN 978-3-662-46867-8 (eBook)
DOI 10.1007/978-3-662-46867-8

Library of Congress Control Number: 2015948149

Springer Heidelberg New York Dordrecht London

Printed on acid-free paper

Springer-Verlag GmbH Berlin Heidelberg is part of Springer Science+Business Media (www.springer.com)

Preface: Smart Cities, You and Me

At the end of 2011, the MIIT and the Directorate General Information Society and Media (now renamed as the Directorate-General for Communication Networks, Content and Technology) at the European Commission launched the Third EU-China Dialogue Meeting on IT, Telecommunication and Informatisation. Mr. Yang Xueshan, vice minister of the MIIT, and Zoran Stančič, deputy director general of the Directorate-General for Communication Networks, Content and Technology, made a joint decision on initiating the EU-China cooperation on green smart cities, establishing an expert framework, and to carrying out in-depth cooperation on pilot cities selected in both China and the EU. A series of intensive preparation ensued that included fifteen cities selected, respectively, in China and the EU for cooperation on green smart cities, the initiation of which was officially declared on the Smart Cities Forum at the EU-China Urbanisation Cooperation Forum (November 21, 2013).

The 15 cities in the EU are Amsterdam (Holland), Barcelona (Spain), Bristol (UK), Copenhagen (Denmark), Florence/Prato (Italy), Frankfurt (Germany), Issy-les-Moulineaux in Paris (France), Lyon (France), Malmo (Sweden), Manchester (UK), Riga (Latvia), Tallinn (Estonia), Venice (Italy), Vilnius (Lithuania) and Zagreb (Croatia).

The 15 cities (including districts) in China are Haidian District (Beijing); Binhai New District (Tianjin); Pudong New District (Shanghai); Nantong, Yangzhou and Huai'an (Jiangsu); Ningbo and Jiaxing (Zhejiang); Zhangzhou (Fujian); Yantai (Shandong); Nansha District (Guangzhou of Guangdong Province); the Shenzhen-HK Modern Service Industrial Cooperation Zone in Qianhai (Shenzhen); Hengqin New District (Zhuhai); Chengdu (Sichuan); and Korla (Xinjiang Uighur Autonomous Region).

On this Forum, the delegates from both sides discussed a series of key issues in the cooperation of green smart cities, such as the management of city operation, services to provide convenience to local citizens, an efficient coordinated mechanism for intergovernmental governance and industrial development and restructuring. On April 28–30, 2014, the pilot cities from both sides held a series of exchange meetings in Beijing, including 'New Urbanisation, Comprehensive Planning, City

Governance, and Urban Civilisation', 'Upgrading Infrastructure and Providing Public Services' and 'Carbon Emission Reduction, Low-Carbon Lifestyle and Environmental Protection'. As one of the organisers of both dialogues, I had personally felt at these meetings a sense of enthusiasm among the delegates from both sides. These policy dialogues had played a significant role in opening up new perspectives, learning best practices and enhancing cooperation between both sides. My personal interest, nevertheless, lies in the difference between the two sides on smart cities.

Frankly speaking, in both China and the EU, urbanisation has had a long history; for some obvious reasons, the process of urbanisation in China did not unfold itself as naturally as it did in European member states. From the European perspective, currently its urbanisation rate falls behind China or Asia. Roughly speaking, three fourths of the European population (circa 350 million) now live in urban areas with a population density greater than 5,000 citizens. Arguably the EU has now entered into a phase of 'post-urbanisation' or 'counter-urbanisation'. The issues that have thus emerged include energy consumption, traffic jam, waste treatment, employment and racial inclusion. According to a European Council estimate, urban areas have consumed roughly 70 % of energy in the EU. Economic loss due to traffic jam takes up roughly 1 % of the European GDP. Under most circumstances, traffic jam takes place in urban areas. At the same time, as far as urban location and structure are concerned, there is no high level of population density in European cities. There are 23 cities with a population over one million and 345 cities over 100,000. Only 7 % of the citizens are living in megacities with a population greater than three million. This highly dispersed, fragmented urban cluster poses great challenges to the issues of waste treatment, racial inclusion and employment, as well as the public services of public health, medical care, education and environmental protection.

As for these issues, the EU aims at providing environmental and energy solutions via ICT, so as to improve resources allocation in urban areas, to open up new channels to make use of social investment in developing and innovating upon smart services and in creating a greater number of employment opportunities and, finally, to achieve the goal of enhancing the competitiveness of their urban areas in the age of globalisation. Nevertheless, the policy framework suggested by the EU places emphasis upon green economy, employment, and improved efficiency of resources and energy allocation. In the EU innovative solution to meet the three major targets of global climate change by 2020, smart cities apparently have become one of the ideal benchmarks. In the published plans (e.g. *EU 2020 Strategy* and *Manifesto for a Resource-Efficient Europe*), green, low-carbon and smart cities have taken up a significant place. By the same token, the report of *Digital Agenda for Europe*, in facing up to the serious circumstance of European member states adversely affected by the international financial crisis, has connected smart cities with the reinvigoration of economy, of which all the proposed priority actions aim at several birds with one stone.

- *Broadband Connection*. 'Broadband Europe' and the 'Common Market for Telecommunication' as published in September 2013, as well as a series of policy reform proposals, aim to improve pan-European connectivity via enhancing high-speed broadband connection. At the same time, the EU has suggested that connectivity is the very systematic solution to smart cities, including a quality telecom infrastructure upon which both entrepreneurs and developers rely.
- *Open Data*. The EU aims at establishing an 'open data by default' system, making the information of the public sector available to citizens, thus to provide convenience to enterprises, citizens and administrative agencies. The regulation on open data enables citizens and enterprises to creatively make use of the information resources available in the public sector. If an enterprise can make use of government data to develop smart, convenient products for citizens, administrative agencies and local enterprises, this shall in no small way benefit such aspects as transport, energy and daily life, as well as provide greater, better and more timely solutions.
- *Incubating Emerging Companies*. The EU has launched a series of innovation projects, the 'Future Internet Lab' included, which aims at providing solutions to such issues as have attracted wide attention during the development of smart cities. Apart from providing the relevant infrastructure for innovation, the EU has paid special attention to optimising such institutional settings as for business start-up and operation, and to building an environment favourable to emerging entrepreneurs, which in no doubt shall accelerate the process of marketisation and commercialisation of innovative products.
- *The Next-Generation Information Infrastructure*. Modern ICT – especially the IoT, cloud computing and generic computers – has its application dependent upon a significant improvement of the transmission and connection speed of information networks. This is also the foundation for city operation and governance. In other words, a smart city, as is based on a broadband, high-speed, reliable, confidential and secure information network, can be regarded as a comprehensive infrastructure for a modern city. To satisfy this requirement, the EU has already asked information network operators to invest in a swift manner in the research, development and experiment of the next-generation network and the 5G. Moreover, the European Commission has established a PPP framework for the development of 5G, so as to provide policy and financial support where necessary.
- *Innovation*. The European Commission has already initiated the Smart Cities and Communities Partnership, which aims at convening all stakeholders of related industries, enabling them to share best experiences and practices and coordinating their actions in meeting challenges. This serves the purpose of boosting interdepartmental innovation across such fields as energy, transport and ICT infrastructure.

Compared with the EU, the difference between China and the EU is demonstrable in terms of the building of smart cities – a difference that can be seen in two aspects. On the one hand, e-governance is not included in the European project of

smart cities, while in China, it is the key aspect. In Europe, the project relies upon a mechanism participated by a plural body of social investors and stakeholders. By way of contrast, in China, the project places emphasis on public finance and private investment, which has exhibited such features as fragmentation, diffusion and lack of orientation. These problems may be related to the demographic scale and geographical distribution of the urban population in China. More importantly, they are related to certain problems confronting urbanisation in China at the moment. A certain number of cities may follow conventional paths of attracting investment and importing emerging industries. Such routinism can lead to the abuse of power or delinquency of certain public policy-making bodies that by no means commit themselves to the substance of smart cities. Unreflectively following the trend will surely lead to nothing else but a result contrary to what one expects, action with undue haste and waste in consequence of hurry. Actions that lack a clear orientation, focus and target will in the end result in misallocation and waste of resources. For this very reason, *EU-China smart city report* is worthwhile of attention and perusal.

Smart Cities: How Far Away?

The first Urbanisation Conference by China's central government was held on December 12–13, 2013, where President Xi Jinping and Premier Li Keqiang delivered speeches of significant import. This Conference clearly indicated that urbanisation, as a natural-historical, long-term process, is the necessary path to modernisation. It also clarified the guidelines, main targets, basic principles and key tasks for China's urbanisation. For one thing, urbanisation possesses both historical and realistic imports in that it can help to solve the 'three agricultural' issues, to drive forwards a coordinated development among different regions, to expand domestic consumption, to promote industrial upgrading, to build an all-round *xiaokang* society and to accelerate the socialist project of modernisation. This Conference required that our efforts to drive forwards urbanisation should start from China's current national situation of being at the primary stage of socialist development. Urbanisation should become a process of natural progress by adapting to circumstances and abiding by laws. Efforts should be made to concretely improve the quality of urbanisation, with a steady improvement of the urban percentage among all registered households; to enhance the efficiency of urban land use and population density of completed urban areas; to optimise the use of energy with reduced energy consumption and carbon emission; to pay a high level of attention to ecological security, with improved ratio of such ecological units as forests, lakes, wetlands as well as with strengthened environmental capacity and water conservation capacity; and to ad infinitum improve environment, reduce the emission of major pollutants, control the intensity of development, enhance the capacity to counter or assuage natural disasters and improve the protection of historical heritage. Urbanisation should be people-based and people-centred, with demographic improvement and citizens' well-being as the core. Likewise, the primary task is to offer a regulated

mode of urbanisation for urban residents who are able to find stable employments and afford a living. A macro-arrangement of urbanisation, should it aspire to become scientifically rational, should adapt to the carrying capacity of local environment, where urban clusters should be set as the main carriers for a reasonable division of labour, functional complementarity and coordinated development among large, medium-sized and small cities and towns. Ecological civilisation is the principle, where efforts should be made to drive forwards a green, recycle and low-carbon mode of development that will reduce to the lowest possible level human interference and damage to the nature, with economical use of such resources as land, water and energy. Chinese cultural traditions should be passed onto next generations, where beautiful towns endowed with historical memories, geographical traits or ethic characteristics should be developed. At the same time, the Conference emphasised that urbanisation should depend not only on the decisive role to be played by market in resource allocation but also on the role to be played by the government in creating institutional settings, drafting development planning, building infrastructure, providing public service and strengthening governance of the society. The central government will provide general guidelines, generic planning and strategic arrangement for urbanisation, while local governments, by adapting to local circumstances, shall implement with consistency the general planning, promulgate corresponding planning and creatively carry out the tasks of building and managing projects.

In March 2014, the Central Party Committee and the State Department published *National Planning on New Urbanisation (2014–2020)*, in which 'to drive forward the building of smart cities' has been clarified. The tasks in this Planning include a comprehensive arrangement of material, information and intellectual resources needed for urban development; to drive forwards the innovative application of such next-generation ICT as the IoT, cloud computing and big data, so as to achieve an in-depth integration of urban social and economic development; to enhance the building of such information infrastructure as information networks and data centres; to promote government information sharing and service coordination across departments, industries and regions, so as to enhance the socialised development and use of public resources, to promote smart information application and new information services and to promote the digitalisation of urban planning and management and smart ICT application to infrastructure, thus rendering public services more convenient, the modernisation of industrial development, and a lean governance of the society; and to enhance the security assurance capacity of core information systems and resources in urban areas. As far as smart ICT application to infrastructure is concerned, this Planning suggests 'efforts should be made to develop smart transport, so as to achieve a smart application to traffic guidance, traffic control, schedule management, and emergency response. We should also develop smart grid, to support a smart management of the access of distributed energy, and the residential and commercial use of power. A smart water management should be in place, so as to build a smart system of water provision, sewage, and pollution treatment that covers the whole process of water provision and ensures the safety and quality of water. A smart pipeline network should be constructed, to achieve a

digitalised management of urban underground space and pipeline networks, as well as a smart monitoring of their operation. Smart architecture should be built, to achieve a smart control of architectural facilities, equipment, energy conservation and health and safety'. As indicated in the requirements to implement this Planning, 'efforts should be made to continuously drive forwards the pilot programmes of innovative cities, smart cities, and low-carbon towns. Existing cooperation platforms (e.g. the Sino-EU Urbanisation Partnership) should be carried towards a profound level, where the exchange with other countries and international organisations should be extended, with pragmatic cooperation in multiple forms and fields'.

As a matter of fact, since 2011, the MIIT has published a series of planning (*The 12th FYP Planning on Digitalisation*, *The 12th FYP Planning on the Development of the Information Security Sector*, *The 12th FYP Planning on the Development of the IoT*, *The 12th FYP Planning on the Development of E-Commerce* and *The 12th FYP Planning on E-Governance*), while the MOHURD published a series of planning and public policies (e.g. *Circular on National Pilot Smart Cities*, *The Provisional Measure for National Pilot Smart Cities* and *The Provisional Index System for National Pilot Smart Cities (Districts or Towns))*. In particular, in August 2013, the State Department published *Several Opinions on Promoting Information Consumption and Expanding Domestic Consumption* and *"Broadband China" Strategy and Its Implementation*. All of the abovementioned planning and public policies have in a clear manner indicated the tasks in building smart cities. In particular, *National Planning on New Urbanisation (2014–2020)* has already upgraded urban construction and planning to a higher level. Moreover, for the first time, it has clearly outlined the comprehensive development guidance and key tasks of smart cities. According to the summary reports of local smart cities planning as published by the research group of EU-China Green Smart City Cooperation, there are greater incentives at the local level towards building smart cities. According to different statistics, by the end of 2013, there were 311 Chinese cities that had proposed or made planning of building smart cities. Nearly two trillion RMB, as a total scale of investment, was put forward in local planning during the Twelfth Five-Year-Planning Period.

In all probability, there are good reasons to believe that smart city, as an imported concept, has 'forced its way' into China during the high tide of new urbanisation. The building of smart cities shall in no doubt be imbued with 'Chinese characteristics' and 'Chinese wisdom', as drawing upon such elements as historical cultural heritage, geographical location, resources attributes, developmental upgrade and environmental pressure. Out of it will be born unique Chinese experiences.

Nevertheless, a serious fact should not be forgotten either. For most Chinese, the city still remains a 'geographical' concept, which denotes a sense of belonging and distance. Even if for those who have lived many years in the city, it is still filled with a sense of nostalgia, as if they were still living in a foreign land. It will be the expectation by the majority of the Chinese to transform the city into a permanent location for job, study and living. It will likewise be the essence of the people-centred principle. The city is the carrier of modern civilisation, thus symbolising rhythm, speed, pursuit of happiness and dreams. To enable citizens to acquire a concrete sense of

belonging and happiness in the midst of traffic jams, human crowds, skyscrapers and competitive commercial flows, this may become the core of modern city governance and management.

Starting from reality, we should have by far had a clear sense of the starting points of smart cities:

- To achieve a unification and smart application to information infrastructure and public infrastructure (e.g. the management of green resources, a dynamic monitoring of environment and the classification of wastes)
- To create a sense of sharing for environmental protection and a low-carbon lifestyle
- To establish a transparent, fair and inclusive mechanism of incentives
- To achieve equal access to basic public services, as well as a universal sharing of knowledge and information
- To drive forwards the modernisation of both the system and the capability to govern the city, with greater and fuller social participation
- To cultivate the plurality and innovation in business models
- To open up the data of public sectors, to bring down barriers and limits between departments and to ensure the entitlements of all stakeholders

The city is the conglomeration and accumulation of time in spatial terms, as well as the means for us to pass on both material and spiritual civilisations from one generation to another. The building of smart cities is an endless project, of which the lasting variables include technical innovation, governance challenges and changing demands. The building of smart cities will by no means follow one path alone. By the same token, there exists no universally valid panacea to cure all ills in the building of smart cities. From the perspective of long-term sustainable development and prosperity of the city, 'smartness' is the future, as well as the diffusion and upgrade of knowledge across generations, and the evolution of civilisation. Citizens and stakeholders are the 'source' of smartness.

Qin Hai

Study Overview and Summary

Smart city development is of significant importance to both EU and China's policy-makers as a means of addressing some of the issues resulting from the rapid process of urbanisation in China and the continuing growth of urban population in Europe. Urbanisation places massive pressure on city infrastructures; cities in the EU consume 70 % of the EU's energy resources and emit the majority of the carbon that is harming the environment. Increased urbanisation in EU and China's cities has led to energy and water scarcity, traffic congestion, problems with waste disposal and safety risks from ageing infrastructures. The adoption of a smart city strategy, which integrates the whole range of services a city needs in a way that follows state-of-the-art public administration requirements through the adoption of ICT solution, can make cities more efficient, reduce costs and ensure and enhance a more sustainable quality of life.

The 'Comparative Study of Smart Cities in Europe and China', funded by the EU-China Policy Dialogues Support Facility II, is the final report of the findings of a study of 15 Chinese and 15 European pilot smart cities. The study examines smart city trends and developments from a global, China and EU perspective. The information captured from the pilot cities on an 'Assessment Framework', which incorporated the key characteristics that are common to smart city projects, enabled the researchers to identify key trends and 'good-practice' examples and understand specific challenges for the pilot smart cities.

The analysis shows the concept of a smart city means very different things to different cities. From the implementation of individual traffic or waste management solutions to the integration of citywide services through the use of ICT comes under the umbrella of 'Smart City'. This is natural, as each pilot city comes from a different starting point, with a different set of social and economic preconditions, natural and geographic settings, economic structures, experience with technological solutions, maturity of infrastructure, etc. As a result it was not possible or deemed useful to provide a single set of recommendations on how to 'get smarter' that would apply to a majority of the pilot smart cities. However, some procedural recommendations have been provided to support all pilot smart cities participating in the EU-China

cooperation project or indeed any other smart city. These recommendations are presented in terms of a roadmap for continuous improvement for the pilot smart cities to advance step by step until reaching the 'state-of-the-art' level of maturity.

The report highly recommends each pilot city utilises the 'Smart City Assessment Framework' developed for the comparative study as an internal management tool for assessing the status quo of their smart city plans, to identify gaps and weaknesses and to focus on addressing those areas where further development is required.

Acknowledgements

Thanks to Mr. Zoran Stančič, deputy director general of DG CNECT, and Mr. Yang Xueshan, vice minister of MIIT, who both initiated the EU-China Green Smart City Cooperation. The cooperation has established an exchange platform for the cities, enterprise and experts; above this platform we can complete this *Comparative Study of Smart Cities in Europe and China*.

This report and the related White Paper on the 'Comparative Study of Smart Cities in Europe and China' were commissioned by the EU Policy Dialogues Support Facility II (PDSF) and Ministry of Industry and Information Technology of China (MIIT). The Chinese expert team was led by Dr. Kang Yanrong of the China Academy of Information and Communications Technology (CAICT) at the Ministry for Industry and Information Technology (MIIT). The European expert team was led by Jeanette Whyte of Jenesis Consulting. The authors would like to express their gratitude to all those who supported and facilitated the work on these documents, in particular:

The participating cities contributed greatly in providing background information on their smart city projects and gave their time generously in completing the Smart City Assessment Framework.

Dr. Qin Hai, director general of the Department of ICT Development and Application in MIIT, gave strong support to the project and provided the preface to this report.

Since EU-China Green Smart City Cooperation started in 2012, Mrs. Cui Zhihua, Mr. Zhang Wang, Mr. Zheng Kai and Mrs. Fang Xinping provided their great efforts to push forwards the cooperation significantly. The China Academy of Information and Communications Technology, as a think tank of MIIT, carried out the concrete jobs, thanks to Mrs. Cao Shumin, the president of CAICT; Mr. Yu Xiaohui, the chief engineer; Mr. Lu Congchun, the director of the Institute of Policy and Economy of CAICT; Mrs. Zhang Xueli; Mrs. Wang Aihua; etc. Mr. Yu Xiaohui did the quality control for this report.

Thanks to Colette Maloney, head of unit for Smart Cities and Sustainability, DG CNECT, and her colleague Merce Griera-I-Fisa for supporting the cooperation.

The PDSF II team was led by Mr. Chris Brown, who ensured overall coordination and gave considerable support throughout. Dr. Shaun Topham liaised with the European cities and the project and gathered relevant information on smart city projects as input for the analysis. The EU Chamber of Commerce in China (EUCCC) provided a valuable platform for engaging with relevant industry and provided enthusiastic support through Ms. Wu Lanna.

Finally, several Chinese enterprises provided smart city-related solutions as input to the report. Huawei provided the support for publication.

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Contents

Abbreviations

API	Application Program Interfaces
BO	Build and Operate
BOT	Build Operate and Transfer
BT	Build and Transfer
BSA	Business Software Alliance
BSI	British Standards Institute
CAICT	China Academy of Information and Communications Technology
CIP	Competitiveness and Innovation Programme
CF	Cohesion Fund
COSME	Competitiveness of Enterprises and SMEs
EEEF	European Energy Efficiency Fund
EIB	European Investment Bank
EIP-SCC	European Innovation Partnership for Smart Cities and Communities
ERDF	European Regional Development Fund
ERDP	European Regional Development Programme
ELENA	European Local Energy Assistance
ESCO	Energy Services Companies
ESF	European Social Fund
ESPC	Energy-Saving Performance Contracts
FP	Framework Programme
FTTH	Fibre to the Home
GeSI	Global e-Sustainability Initiative
GHG	Greenhouse Gas
ICF	Intelligent Community Forum
ICGF	Infrastructure Credit Guarantee Fund
ICT	Information and Communication Technology
IDA	Infocomm Development Authority of Singapore
IEE	Intelligent Energy Europe
IFI	International Financial Institutions
IoE	Internet of Everything
IP	Internet Protocol

IoT	Internet of Things
ITDP	Institute for Transportation and Development Policy
ITI	Integrated Territorial Investment
ITS	Intelligent Transport System
JESSICA	Joint European Support for Sustainable Investment in City Areas
LED	Light-emitting diodes
M2M	Machine-to-machine
MIIT	Ministry of Industry and Information Technology
MOHURD	Ministry of Housing and Urban-Rural Development MOHURD
MOST	Ministry of Science and Technology
NDRC	National Development and Reform Commission
NFC	Near Field Communication
NICE	Networking Intelligent Cities for Energy Efficiency
OASIS	Online Policy Suggestion System
P2M	Person-to-machine
P2P	Person-to-person
P3GM	P3 Global Management
PDSF	Policy Dialogues Support Facility
PPP	Public-Private Partnerships
P*P*P	Providing Portability of Best-Practice Project
RFID	Radio Frequency Identification
RSFF	Risk-Sharing Finance Facility
SEAPS	Sustainable Energy Action Plans
SIP	Strategic Implementation Plan
TIF	Tax Increment Financing
TOD	Transit-Oriented Development
UDP	Urban Development Platform

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Chapter 1
Introduction

1.1 Background

At the end of 2011 in Chengdu, in the context of the 3rd ICT Dialogue Meeting between the Ministry of Industry and Information Technology (MIIT) and the European Commission's Information Society and Media Directorate-General (now DG CNECT), Vice Minister Yang Xueshan and Deputy Director General Zoran Stančič jointly determined to:

- Develop 'Green Smart City' cooperation
- Establish an EU-China smart city expert framework, which includes a steering committee, technical expert group, and secretariat
- Select pilot cities from China and the EU

The project was formally launched in April 2013 and a technical expert group, with representatives from the EU and China, was established. This *final* report provides the technical expert group's findings on the developments and EU-China Smart City Cooperation. It also provides an analysis of the emerging trends and open challenges for smart cities in Europe and China together with recommendations for further action.

The EU-China Policy Dialogues Support Facility (PDSF) is a project co-funded by the European Union and China to facilitate and support current and future implementation of policy dialogues between the EU and China on a broad range of key sectors and issues, with the overall aim to strengthen strategic relations between the EU and China. One of the areas supported by the PDSF is the EU-China cooperation in the field of smart cities.

A White Paper, which summarises the key findings of this report, can be downloaded at http://www.eu-chinapdsf.org/.

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_1

1.2 Methodology

The methodology used to achieve the objectives of the EU-China Smart City Cooperation PDSF programme is depicted in Fig. 1.1, below.

1 In May 2013, the technical expert group held its first meeting in Guangzhou and agreed a work plan and the key deliverables for the programme.

2 Subsequent to this meeting a Smart City Assessment Framework was agreed, details of which are given in Sect. 4.1 of this report. Both the EU and China selected 15 pilot smart cities that completed the assessment framework, according to the selection criteria described in Sect. 4.2 of the report. The 30 pilot cities are shown below in Fig. 1.2.

3 An analysis of the data obtained from the pilot Smart City Assessment Framework was undertaken and the results are provided in sections 5 and 6 of the report.

4 5 In parallel with the analysis of the pilot smart cities, desk research and discussions with smart city solution providers was undertaken. A summary of these findings is given in section 2 of the report.

6 A first *draft* of the EU-China Smart City Cooperation report was produced in November 2013.

7 The technical expert group met in November to review the first draft report and incorporate feedback from the 'EU-China Partnership on Urbanization 2013 –

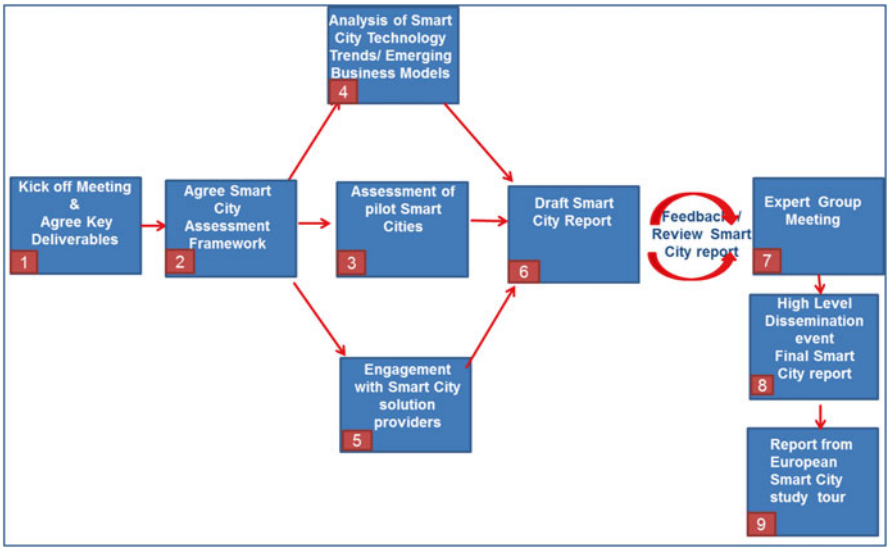

Fig. 1.1 Study methodology

European Pilot Smart Cities	Chinese Pilot Smart Cities(by Administrative Region)
Amsterdam, Netherlands	Beijing Haidian District
Barcelona, Spain	Tianjin Binhai New Area
Bristol, UK	Shanghai Pudong New Area
Copenhagen, Denmark	Yangzhou of Jiangsu Province
Florence, Italy	Nantong of Jiangsu Province
Frankfurt, Germany	Huai'an of Jiangsu Province
Issy-les-Moulineaux, France	Ningbo of Zhejiang Province
Lyon, France	Jiaxing of Zhejiang Province
Malmö, Sweden	Zhangzhou of Fujian Province
Manchester, UK	Yantai of Shandong Province
Riga, Latvia	Guangzhou Nansha District of Guangdong province
Tallinn, Estonia	Authority of Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone of Shenzhen, Guangdong province
Venice, Italy	Zhuhai Hengqin New Area of Guangdong province
Vilnius, Lithuania	Chengdu of Sichuan Province
Zagreb, Croatia	Korla of Xinjiang Uygur Autonomous Region

Fig. 1.2 EU-China pilot smart city

Smart City Sub-Forum'. Feedback from other interested stakeholders such as the EU Chamber of Commerce in Beijing will also be encouraged and incorporated into the final report.

8 The *final* EU-China Smart City Cooperation report will be presented at the high-level dissemination event, which will be held in Beijing in April 2014.

9 A European smart city study visit took place in the summer to progress the recommendations from EU-China Smart City Cooperation report.

1.3 Scope of the Report

This report contains the findings of the activities for phases 1–7, as described in Fig. 1.1 above of the study.

Chapter 2 provides an overview of global smart city trends and developments and summarises the key developments in China and the EU.

Chapter 3 describes the EU and China's policy framework for smart city development.

Chapter 4 explains the selection criteria used to select the 15 pilot smart cities in Europe and China. This chapter also includes a description of the Smart City Assessment Framework, which was used to collect data from the pilot.

Chapter 5 provides a synopsis of the information provided by the EU and China pilot smart cities.

Chapter 6 presents an assessment of the EU and China pilot smart cities level of maturity – basic level or 'more advanced' level – with respect to the key characteristics of a smart city.

Chapter 7 reveals the emerging trends and open challenges encountered by the EU and China pilot smart cities.

Chapter 8 provides a roadmap for continuous improvement for the pilot smart cities.

Chapter 9 provides suggestions for next steps.

Chapter 2
Smart City Trends and Developments

2.1 Definition of Smart City

There is no standard definition of what constitutes a 'smart city'. A common denominator is that a smart city is first and foremost a city – one that pushes the quality of resource management and service provision to the limit possible at the time. In such an integrated understanding of the smart city concept, smart city projects are part of a general concept of city modernisation. While the potential contribution and benefits of information and communication technology (ICT) to modernisation can be considerable, smart city projects should never be seen in isolation, but as one element in a city's (or a region's) continuous effort to find the next best way of operations.

Smart city is a new model that builds upon previous views of city development. Since the Industrial Revolution, the quality and scale of cities have expanded significantly with urbanisation playing an important role in increasing the value of the cities and improved regional power. However, increased urbanisation has resulted in some negative effects such as overconsumption of resources, environment degradation and the widening gap between the rich and the poor. To overcome these problems and challenges, cities have encountered many new concepts of city development such as knowledge city, eco-city, digital city, liveable city and low-carbon city. These concepts have provided new ways for city development.

From this starting point, it also is evident, however, that interpreting smart city projects as technology projects alone would be a mistake. Given the continued urbanisation process and in consequence of the increased population density and resource consumption of cities around the world, the start of any city modernisation process needs to be rooted in the question of what kind of place cities want to become: how should the target of 'quality of life' be defined, the realisation of which can then be supported by technology solutions?

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_2

A city planning its future development path is therefore well advised to start the thinking process by taking a step back from technology and considering what kind of expertise is required to answer some more fundamental questions such as:

- Why and how will the city grow?
- What will be the age structure and range of professional activities of its citizens?
- What kind of medical services will be required?
- What kind of social interaction is desirable?

Also, factors beyond the influence of the city itself, such as future energy costs, regional and international migration developments and/or shifts in the socio-economic composition of the population, must be assessed. Ideally, this discussion will be conducted by all stakeholders, city governments as well as citizens and enterprises, supported through the expertise of all relevant disciplines, from city planners, architects, services experts, sociologists and psychologists to technology and security experts.

In its widest understanding, smart city integrates the whole range of services a city needs and wants to offer in a way that follows state-of-the-art public administration requirements – including the use of most recent technology. The goals of 'good city management' are therefore ideally also the leading goals of smart city development: today, on a meta-level, these can be summarised as 'low-carbon use' and 'high quality of life'. As collection, exchange and processing of data are vital to the management of any institution as complex as a city, ICT is promising to make a substantial contribution to the way a city approaches its tasks.

Based on the above analysis, a smart city is a new model that builds on previous views of city development. It is a new type of city development based on in-depth exploration and wide application of new generation of ICT technology. It includes new measures and solutions to help transform government functions to improve the innovation of social management. Smart city is based on the convergence of innovative application of ICT technology with city transformation and development, and it is vital to the green, low-carbon and sustainable development of the cities. A smart city strategy can assist cities in realising sustainable targets such as high efficiency, high-end economy, better life of people and more beautiful city environment.

Many organisations have created their own catalogues of criteria to define whether a city is smart or not. Those criteria typically can include all or some of the terms listed below:

- Smart energy production and conservation
- Smart mobility
- Smart economy
- Smart living
- ICT economics
- Smart environment
- Smart governance
- Standard of living
- Smart society

Breaking the smart city concept further down into specific systems and applications, smart cities can be characterised by the presence of one or several of the examples shown in Fig. 2.1 below or, in the case of a comprehensive approach, by an integrated system seeking to create a one-stop city management approach by integrating a majority of them, facilitating the government's task to operate all functions through some form of centrally organised (literal or metaphorical) 'control room', working on the basis of what is sometimes referred to as a 'city operating system'.

Another term frequently used is 'eco-cities' – a term that overlaps and is sometimes used interchangeably with smart cities or 'sustainable cities'. Eco-city projects typically focus on carbon emission reduction targets, economic development goals and designs that aim to promote healthy, socially and environmentally sustainable communities. For example, many EU smart city-related activities focus on smart city projects as one important element in achieving the union's 2020 energy objectives, as adopted by the European Council in 2007.

The Smart Cities Group of the FTTH Council Europe has formulated that for a city to be labelled 'Smart': it must have implemented all of the three defining initiatives:

- A strong and reliable communication network, preferably based on fibre optics
- Government involvement to provide added value to the citizens
- Initiatives to promote the use of renewable energy

Smart city, digital city, wireless city and future city are sometimes terms that are used synonymously, which may lead to confusion. The smart city concept may include digital cities and wireless cities. A 'smart city' would in this case describe the integrated management of information that creates value by applying advanced

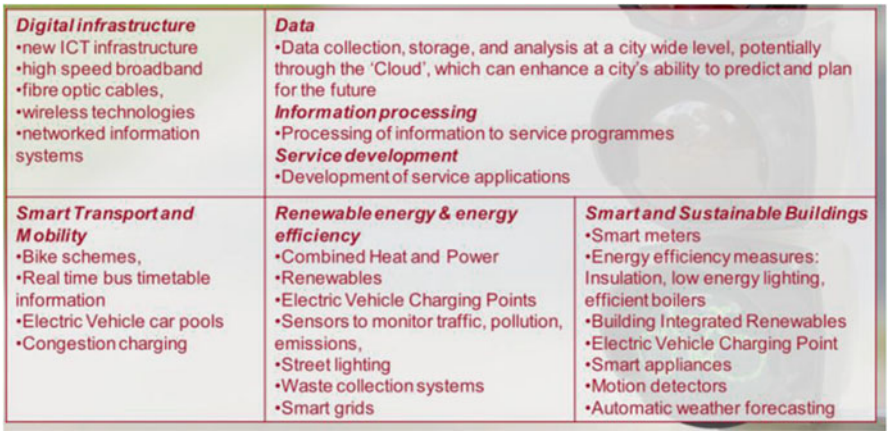

Fig. 2.1 Definition of smart city (Source: Hirst, JESSICA for Smart and Sustainable Cities, 6 Nov. 2011)

technologies to search, access, transfer and process information. 'Smartness' here is seen as an infrastructure quality. The 'digital city' concepts can, however, be narrower than the smart city concept as used here: e.Republic's Center for Digital Government and Digital Communities ranking of 'digital cities' shows that most of these cities would not qualify as being 'smart', as they focus on the electronic provision of certain services or on the improvement of infrastructure, but do not include integrated management of the city functions, such as utilities, traffic, etc. Such digital cities would typically provide services such as:

- *e-Government*: to increase the efficiency of governmental back-office process and the range of services offered to citizens
- *e-Traffic*: to mitigate heavy traffic by electronically monitoring and diverting traffic while reducing emissions and energy consumption through the remote control of stop lights and other energy-guzzling devices
- *Surveillance*: to monitor the city in real time to help prevent crime, conduct research and allocate resources appropriately
- *e-Health* and *e-Education*: to provide citizens with access to high-quality medical care and education at home or by experts from remote locations
- *e-Home*: to help improve household convenience and safety, through integrated and remote monitoring and appliance management

A 'future city' is one which is focused on providing *physical* projects which are often but not exclusively associated with low-carbon economies. In comparison a smart city combines both physical and digital infrastructure or can be based on digital infrastructure alone.

The smart city concept can also be extended into aspects not or only slightly connected to the operational management of a city. For example, the Intelligent Community Forum (ICF) uses the approach to award communities that provide a model of economic and social development in the twenty-first century using information and communication technology to power growth, address social challenges and preserve and promote culture. The projects these cities stand for are for the most part not smart projects in the more integrated sense of the term but rather represent individual modules of improving specific aspects of a community's inner workings.

Most smart city projects are actually of this kind: development and implementation of individual solutions to individual problems identified in a community rather than comprehensive overhauls of the way cities are managed. Large-scale integrated city resource management is a task almost exclusively limited to newly developed greenfield projects. These (few) projects serve as an important test bed from which to learn – but this does not mean they are the necessarily directly transferable best practice. Designing a modern city from scratch is without precedent, and it can be expected that this design process is prone to a whole different set of errors, oversights and unforeseen complexities than the modernisation of an existing city system. While the modernisation of an existing city provides guiding restrictions in the form of the requirement of uninterrupted operation, fundamental design flaws or omissions of a greenfield

project may only become visible years later, when the city starts getting populated with citizens and enterprises.

Existing cities with historically grown infrastructure and administration systems will require a more moderate step-by-step approach to modernisation. Creating technology hubs or green areas of the city therefore are among the more common examples of smart city projects, as are limited-scale experiments with smart electricity grids, the introduction of electric buses or bike-sharing schemes. Because of its high level of controlling a valuable learning field for a city government, projects are also common focusing on city property or property under strong control by the cities: the transition towards a 'green-car fleet' is frequently found, through procurement provisions requiring purchase of low-emission vehicles or through a more fundamental switch towards electric vehicles. Specific requirements for public buildings or social housing is another such example, where a systematic introduction of ICT-based energy management services, energy decision support and awareness raising for tenants or workers is more easily piloted and shared (i.e. through programmes such as 'Smartspaces' or 'eHouses') than through building requirements or incentives for the private sector.

While adding new services to a city in full operation (such as intelligent guiding systems to available parking spaces) does not interfere too much with the regular city management procedures, upgrading a vital part of the infrastructure to next-generation technology is a more complex task: introducing smart metering for water or electricity use, for instance, requires something akin to open-heart surgery on a city's infrastructure, with the imperative of upgrading the system without disrupting the service or the utilities' ability to keep track on usage. These old cities have to take into account ageing (or at least existing and operational) infrastructure and city management procedures that are often well established.

2.2 Global Trends and Developments

The size of the global smart city market is large and growing albeit the estimates of market size and number of smart city projects vary widely, as can be seen from Fig. 2.2, below.

A summary of smart city global trends and developments, which are driving the growth of this market, is provided below. The summary is by no means exhaustive; the objective is to include the key trends that may be of significance in highlighting 'good practice' in the development of smart cities in the following seven areas:

- Governance
- Financing
- Business models
- Smart city services
- Technology
- Smart city communities
- Government policies

Data source	Smart city market size/number of projects
ABI Research	Smart city technology market in 2013 is USD 8.1 billion and will grow to reach USD 39.5 billion by 2018
Frost & Sullivan[a]	Market global opportunity in smart city market to total USD 3.3 trillion by 2025
GSMA's Connected Living Tracker[b]	In 2012, there were 257 mobile smart city projects of trial or commercial projects in the Americas (38), Europe (166), Asia (38) and Africa/Oceania (11)
International Data Corporation	Estimated mainland China's city market to be worth $10.8 billion in 2013 and forecasts double-digit growth for the next 5 years[c] Worldwide smart city spending on the Internet of Things will be $265 billion in 2014. Smart cities will redirect 15–20 % of traditional IT spending to the cloud. Forty-five percent of all big data use cases will be in financial performance, public safety and transportation[d]
Lee & Hancock's analysis of data from IBM, CISCO, ABI Research, Gartner (2012)[e]	In 2012, there were 143 smart city projects ongoing or completed in North America (35), South America (11), Europe (47), Asia (40) and the Middle East and Africa (10)
Pike Research	Smart city technology market in 2012 is USD 6.1 billion and will grow to USD 20.2 billion in 2020

[a]Source: http://www.menafn.com/f50a50b0-b362-44c9-8d64-88cb2dc34440/Frost--Sullivan-Connected-and-Intelligent-Infrastructure-eGovernment-Services-and-Smart-Security-Solutions-to-Drive-Smart-City?src=main.
[b]Source: GSMA Connected Living Tracker http://www.gsma.com/connectedliving/tracker.
[c]Source: IDC's China 100 Smart Cities Evaluation and Recommendation: Penetrating the Appropriate Target Cities Is Key, July 2013.
[d]Source: Research from the Smart City Council http://telecomtv.com/comspace_newsDetail.aspx?n=50754&id=e9381817-0593-417a-8639-c4c53e2a2a10.
[e]Toward a framework for Smart Cities: A Comparison of Seoul, San Francisco & Amsterdam', Jung-Hoon Lee.

Fig. 2.2 Smart city market size

2.2.1 Governance

The vision of how a smart city should be built and run is moving away from the traditional 'closed and top-down' approach to a more 'open model'. City officials are recognising there is an opportunity to develop an innovative and inclusive smart city by ensuring there is an open and transparent governance system. Some of the tools and techniques that cities are using to achieve a participative governance model include:

- Open and inclusive networks
- Open data infrastructure

- Visualisation
- Simulation and gaming
- Citizen engagement
- Integrated management structures

2.2.1.1 Open and Inclusive Networks

An example of a city that is embracing an open governance model to meet its smart city objectives is Seoul, the capital of South Korea. Seoul has a citywide high-speed broadband optical wire and wireless network. An administrative optical network called 'e-Seoul Net' was established in 2003, embedding fibre-optic cable along Seoul's subway tunnels to connect the city's main public buildings, its affiliated offices and municipalities. The network was updated in 2011 to support new smart services and the 192-km 'u-Seoul Net' providing citizens with free Wi-Fi service and full access to public websites and enabling metropolitan government to handle huge amount of data generated from a variety of smart devices. With 'u-Seoul Net', citizens have access to administrative services anytime, anywhere.

'u-Seoul Net' is divided into three communications subnetworks:

- A Wi-Fi network used to serve administrative functions
- A CCTV network enabling the exchange of video data generated by Seoul's 30,000 CCTV installations
- The u-service network, which connects the websites of all the public offices under the Seoul Metropolitan Government, allowing citizens to bypass Internet service provider networks and instead access u-Seoul Net for free information on city services

A key pillar of Smart Seoul 2015 is to increase access to smart devices and to educate new users on their operation. In 2012, Seoul began distributing second-hand smartphone devices to low-income families and others in need. Citizens are encouraged to donate their old devices when buying new ones by receiving tax deduction. Seoul has been providing education courses on smart ICTs since 2009, offering both city-run lectures and city-funded smart ICT classes through private education institutions. Aimed at immigrants, low-income individuals and elderly people using smart devices for the first time, these classes attracted over 47,000 people over 2009–2011.[1]

2.2.1.2 Open Data Infrastructure

More and more cities are opening up their databases to the public in order to encourage the reuse of the data stored in them so that businesses and individuals can create value out of the data, both for themselves and for their citizens. For example, Open

[1] Source: 'Smart Cities Seoul: a case study', ITU-T Technology Watch Report February 2013.

Square,[2] launched in April 2012, is a mechanism through which Seoul discloses administrative information to citizens and the private sector. There are 880 different data sets, which provide information on childcare services, public transportation routes, bus arrival times, parking availability, weather conditions by region and Seoul's recommended restaurants, all accompanied by maps, Internet links, graphs or statistics. The data is freely available, and city administration encourages the information to be used to develop smart city applications that improve the efficiency and quality of public services.

2.2.1.3 Visualisation

Singapore is another good example of a city that is using technology to achieve an open governance model. LIVE Singapore![3] provides the citizens of Singapore with access to an open platform of real-time information about the city. LIVE Singapore! uses visualisation to help extrapolate meaning from the vast amounts of data produced by the city that of interest and relevance for its citizens. For example, one of the visualisations is city data that is combined with GPS data from taxies. Singapore's mobility is heavily reliant on taxies, and when it rains, it is very difficult to get a taxi. One of the practical outcomes of the visualisation of the data was for the city to design streets more sensibly and create practical software applications to help people catch taxies.

2.2.1.4 Simulation and Gaming

Computer simulation tools and gaming[4] may also contribute in providing a more open approach towards the governance and planning for smart cities. For example, Singapore is developing a complex system modelling tool[5] that has the ability to simulate various built environments, which also takes into account the behaviour of the residents and then recommends an optimal scenario to meet the desired outcome of the living environment. The tool reduces the risk of physical trial and error by providing a virtual platform for testing a planned environment before developments are actually implemented.

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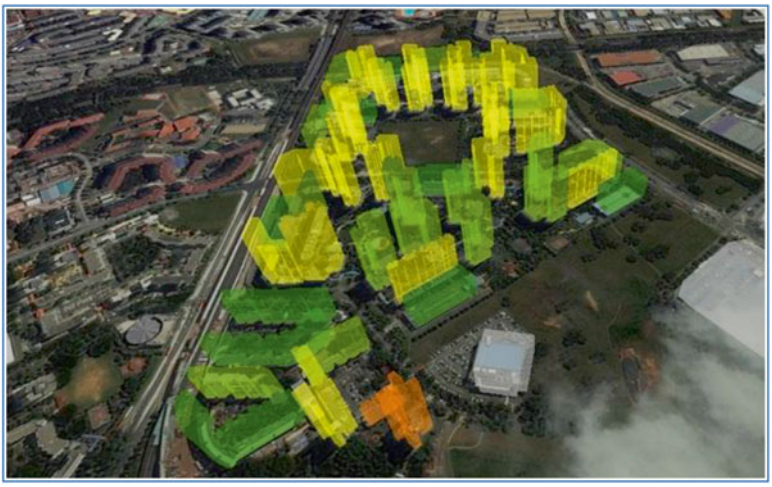
[2] Seoul Open Data Square, http://data.seoul.go.kr/index.jsp.

[3] LIVE Singapore! is a project of SENSEable City Lab and part of the Future Urban Mobility research initiative at the Singapore-MIT Alliance for Research and Technology (SMART) and funded by the National Research Foundation (NRF) of Singapore.

[4] Gaming here refers to 'gamification', which is defined by Andrzej Marczewski as 'The application of gaming metaphors to real life tasks to influence behaviour, improve motivation and enhance engagement'.

[5] In June 2013, Singapore's Housing & Development Board signed a research collaboration agreement with European companies Electricite de France (EDF) and Veolia Environnement Recherche et Innovation.



Source: http://www.hdb.gov.sg/fi10/fi10296p.nsf/PressReleases/FAFC60FD82B4773648257B8700237C45?OpenDocument.

IBM's 'CityOne Game'[6] and 'Play the City'[7] are games which have been utilised by cities such as Istanbul, Amsterdam, Chicago, Memphis, New York and San Jose as a means to build communities of interest, codesign with stakeholders and create strategies for urban development.

2.2.1.5 Citizen Engagement

Best-practice smart cities understand the importance of enabling, engaging, encouraging and empowering citizen initiatives to achieve transformative economic, social and environmental benefits. For example, Seoul encourages its citizens to contribute ideas about city policies and to discuss suggestions directly with city officials through OASIS, an Online Policy Suggestion System.[8] The ideas suggested by citizens through OASIS follow three stages to become city policies:

- Ideas are reviewed through online discussions, with the participation of public officers, experts and citizens.
- Ideas are reviewed through offline meetings between the citizen who proposed the idea and policymakers in order to expand the proposal and to establish feasibility.
- Ideas are implemented into policy.

[6] http://www-01.ibm.com/software/solutions/soa/innov8/cityone/index.jsp.

[7] http://www.playthecity.nl/.

[8] Source: Networked Society City Index – citizen perspective; Ericsson and Arthur D Little.

In a report by the Institute for the Future and the Rockefeller Foundation,[9] it suggests there is a role for entrepreneurs, hackers and 'citizen hacktivists' whose vision of the future city is that urban data in the form of information can promote cities that are more democratic, more inclusive and more resilient. These do-it-yourself urbanites use open-source technologies and cooperative structures for citizen-driven initiatives, strengthening social commitment and ensuring that technological process remains in line with civic interests. Many cities around the world are organising 'hackathons' which allow teams of hackers to 'hack' large data sets (such as weather/transport/traffic data) over a short amount of time and for these teams to unravel and translate this data into a useable application that engages citizens. For example, the Infocomm Development Authority of Singapore (IDA) organised a 2-day hackathon, which attracted over 150 participants, including urban planners, architects, sustainability experts, technologists, researchers, developers and designers to cocreate new prototypes to help Singapore become a more liveable, competitive and sustainable city.[10]

2.2.1.6 Integrated Management Structures

Not all cities have a single, transparent governing body that is responsible and accountable for delivering smart city developments. Instead many cities have fragmented management structures that split the various layers of governance such as federal, municipal and city, which then leads to increased inefficiency and wasted resources. However, there is a growing trend among successful emerging market cities in implementing new types of management structures that enable faster and more accountable decision-making. For example, for its Rio + 20 Initiative,[11] Rio de Janeiro established a 'delivery unit' comprised of cross-functional staff that are dedicated to the delivery of the city's goals.

> *"Transparency helps departments in Rio de Janeiro work together for better city services and outcomes",* Rodrigo Rosa, Special Advisor to the Mayor on Sustainability, Rio, Brazil.[12]

2.2.2 Financing

Smart city projects require substantial financial investment and financing remains one of the greatest challenges facing smart city initiatives. Financing of smart city projects may be provided by government funding, either through state-owned

[9] Source: 'A Planet of Civic Laboratories', 2011 http://www.iftf.org/fileadmin/user_upload/downloads/IFTF_Rockefeller_CivicLaboratoriesMap.pdf.

[10] Source: http://www.upsingapore.com/data-in-the-city/.

[11] Rio + 20 is the short name for the United Nations Conference on Sustainable Development, which took place in Rio de Janeiro in June 2012.

[12] Source: page 20, 'Information Marketplaces: The New Economics of Cities', the Climate Group | Arup | Accenture | Horizon|.

banks such as the case for Masdar City[13] or from direct public sector financing. However, for most smart city projects, private sector investment is required to fill funding gaps.

Some of the most common financial instruments utilised by cities globally, for smart city projects include:

- Public-private partnerships
- Green bonds
- Energy-Saving Performance Contracts
- Tax increment financing
- Crowd funding
- Private Investment

2.2.2.1 Public-Private Partnerships

Private sector involvement in smart city projects can take the form of public-private partnerships (PPPs), in which the long-term risk is transferred to the private sector. There are many successful examples of PPPs that have been deployed to fund smart city developments across the globe as can be seen in Fig. 2.3 overleaf.

However, there has been some reluctance by cities, notably in the USA, to allow private funds to own core infrastructure and an even greater reluctance to allow private companies to profit from the infrastructure. Examples of initiatives which have been deployed to stimulate PPP funding for smart city projects include:

- *Financial and tax incentives*: the government of South Korea has introduced various kinds of financial and tax incentive policies to facilitate smart city infrastructure PPP financing, to support its First 5-Year Action Plan for Green Growth, initiated in 2009. Incentives include[14]:
  - Construction subsidies: the ratio of subsidy to construction cost for environmental projects is stipulated by law (50–80 %) where more green-oriented projects are eligible for larger subsidies than the other projects.
  - Compensation for base cost: the government assumes a portion of investment risk. This risk is limited to what the government's costs would have been in the case of a public-financed project; subsidies are provided only when the actual operational revenue surpasses 50 % of investment risk.
  - Infrastructure credit guarantees via the Infrastructure Credit Guarantee Fund (ICGF): the ICGF provides credit guarantees to concessionaires who want to obtain loans from financial institutions for PPP projects.

[13] Masdar City is a greenfield smart city project funded by the government of Abu Dhabi and administered by Masdar, a government-owned investment vehicle that manages projects to support the growth and economic diversification of Abu Dhabi.

[14] Source: page 33, 'Financing Green Urban Infrastructure', OECD Regional Development Working Papers 2012/10.

	Activity	City	Country	Governance	Type of contract
Transport	Bicycle sharing	Paris	France	PPP	Concession
		London	UK	PPP	
		Barcelona	Spain	PPP	
		Oslo	Norway	PPP	
		Lyon	France	PPP	
		Stockholm	Sweden	PPP	
		Brussels	Belgium	PPP	
		Seville	Spain	PPP	
		Dublin	Ireland	PPP	
		Copenhagen	Denmark	NGO	
	Bicycles paths	Bogota	Columbia	In-house	
	Congestion change	Stockholm	Sweden	Procurement	
Energy	Renewable energy supply	Austin	USA	In-house	
		Melbourne	Australia	Procurement	Supply and install
		Rizhao	Chino	Public	Regulation, subsidy
		Barcelona	Spain	Public	Regulation
	Energy savings	Chicago	USA	In-house	
		Copenhagen	Denmark	In-house	
		Tokyo	Japan	Public	Regulation
	Street lighting	Los Angeles	USA	In-house	
Building	Energy savings	Berlin	Germany	PPP	ESP
		London	UK	PPP	EPC
		Stuttgart	Germany	In-house	
		Paris	France	PPP	PFI[3]
Urban development		Dongguan	china	PPP	
Waste	Waste management	Gothenburg	Sweden	PPP	Management contract
		Sydney	Australia	PPP	BOO
		Dhaka	India	NGO	
Water	Water distribution	Tokyo	Japan	In-house	
		Emefuloni	South Africa	PPP	BOT
		Austin	USA	Public	Regulation,subsidy

Fig. 2.3 C40 (Climate Leadership Group) 'best-practice' projects (Source: page 30, 'Financing Green Urban Infrastructure', OECD Regional Development Working Papers 2012/10)

  - Tax incentives in four categories: special taxation, corporate tax, local tax and exceptions from charges.

- *Enlisting the support of a champion*: P3 Global Management (P3GM), a US privately owned company, enlisted the support of Bill Clinton to help change the minds of city mayors in the USA about the benefits of PPP.

In June 2013, at the Clinton Global Initiative, the US Conference of Mayors, which represents more than 1300 cities, passed a key resolution to support public-private partnerships in America. As part of the agreement, P3GM will work with US cities to develop smart city public-private partnerships, provide the upfront cash

investment for the project and implement a range of smart city solutions such as networked light-emitting diode (LED) street lighting, increased broadband access, interactive informational kiosks and public Wi-Fi hotspots. In return, P3GM secures the long-term management and investment rights of the assets.

2.2.2.2 Green Bonds

Green bonds are financial instruments that cities may utilise to attract private finance for smart city projects. Green bonds are fixed-income securities issued to raise capital for a project that contributes to a low-carbon, climate-resilient economy. Green bonds can be issued by governments, multinational banks or corporations, which most to date have been issued as AAA-rated securities by the World Bank and other multilateral development banks.

Green bonds have been designed to attract capital from institutional investors or as a means for governments to direct funding to climate change mitigation. The current market size for all green bond issuance, approximately USD 15.6 billion, is still marginal (0.017 %) compared to the capital held in global bonds markets.[15] Some cities such as Chicago have developed their own green bond programme for energy efficiency and renewable energy goals.

2.2.2.3 Energy-Saving Performance Contracts

Energy-saving performance contracts (ESPCs) have been used to fund smart city projects notably in the USA. The initial capital investment is provided by the financial community and the services are delivered by energy service companies (ESCOs). The financier is paid back out of the accrued energy savings, with the ESCO guaranteeing a certain level of savings or performance. If the performance standards are not met, the ESCO is responsible for paying back the loan.

An example of where this type of financing was implemented is in the City of Houston. Schneider Electric leveraged an ESPC to perform energy efficiency retrofits on 40 municipal buildings. The infrastructure upgrades decreased the city's emissions and boosted its sustainability rating and also saved the city $3 million annually in energy and water costs.[16]

2.2.2.4 Tax Increment Financing

Tax increment financing (TIF) is an economic development tool used in the USA and Canada to encourage the redevelopment of areas in need of revitalisation and brownfield remediation. Cities designate a TIF area for capital improvements and

[15] Source: page 43, 'Financing Green Urban Infrastructure', OECD Regional Development Working Papers 2012/10.

[16] Source: 'The Smart City Cornerstone: Urban Efficiency', by Charbel Aoun, Schneider Electric.

then earmark any future growth in property taxes to pay for investments in infrastructure and other economic development initiatives.

TIFs were first introduced in the USA in 1952 and have been widely used by some states. For example, in Chicago, 10 % of all property taxes were earmarked for TIF purposes, and TIF districts covered more than 25 % of the city's geographical area. TIFs were first introduced in Canada in 2008 and are not nearly as widespread as in the USA.

2.2.2.5 Crowd Financing

Crowd financing is a method of raising funds from individuals who network and pool their money, usually via the Internet, to support efforts initiated by other people or organisations. Although this funding mechanism is still in its infancy, crowd funding has been identified as a potential funding mechanism for supporting city-wide projects and overcoming barriers related to financial and other constraints.[17] For example, the City of Chicago is a case where local community members are willing to play a role in the implementation of renewable energy projects through a community-based crowd-funding model.[18]

2.2.2.6 Private Investment

Some smart city projects are funded entirely by private companies. For example, the City of Incheon gave development rights to a 70/30 partnership between developer Gale International, a global estate development and investment firm, and construction manager POSCO E&C, a Korean steelmaker, to develop New Songdo City.[19] The project has an estimated cost of $35 billion and in 2006 Morgan Stanley became the first financial institution to make direct cash investment, totalling $350 million.

Private companies may also be prepared to help fund smart city projects when they can directly benefit from the project. For example, Duke Energy provided USD4.1 million to set up an energy efficiency project in Charlotte, USA. The project, which uses connected electricity meters to better match supply and demand and educate employees on more efficient energy usage. The benefit for Duke Energy is that the project helps it anticipate and meet peaks in demand without having to invest in costly new generating infrastructure, and in addition the lost revenues resulting from reducing energy consumption are paid to Duke Energy by the North Carolina Utility Commission.

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[17] Smart Cities Stakeholder Platform, Finance Working Group, Guidance Document, Financing Models, For Smart Cities, Jorge Núñez Ferrer (Chair of Finance Group), June 2013.

[18] Source: 'FINANCING LOCAL RENEWABLE ENERGY PROJECTS: Encouraging private investment in Chicago's energy future', Mark Silberg.

[19] New Songdo City, located on a man-made island about 40 miles from Seoul, South Korea. Its overall development goal is 'Compact, Smart and Green'. Plans are to emit only one-third the greenhouse gases of a similar-size city.

2.2.3 Business Models

Cities across the globe are exploring new business models to fund their smart city projects. Some examples of emerging and innovative business models include:

- Cloud-based, pay-as-you-go models
- Creating revenue from data
- Pilot projects
- Smarter procurement

2.2.3.1 Cloud-Based, Pay-As-You-Go Models

Increasingly cities are making use of cloud-based or managed smart city services, paid for on a pay-as-you-go basis, as a more cost-effective solution than investing in their own dedicated infrastructure. As well as reducing the need for upfront capital spending, a cloud service provider may also be able to achieve economies of scale and scope and hence reduce the cost of delivering the service.

South Korea's Busan smart city is using a cloud-based infrastructure delivered by a partnership between the local government, Cisco and Korea Telecom (KT). The cloud-based architecture enables the provision of new smart city services to a large number of users. The public-private partnership set-up between Busan Metropolitan City, Cisco and KT shares both the costs and the risks of the project. The role of the mobile operators in this model goes beyond connectivity. KT, for example, has been instrumental in supporting and investing in the design and development and manages the overall operation of Busan smart city platform. KT is also providing several crucial enablers of the new cloud-based model: its mobile broadband network contributes to deliver ubiquitous coverage and bandwidth for the city, while cloud-based applications are accessible via mobile and embedded devices. The initial results of the smart city project show that it is a new source of revenue for the government, the first-year revenue in excess of USD2.2 million, and a driver of new jobs in local companies.[20]

2.2.3.2 Creating Revenue from Data

Cities, such as San Francisco, Seoul, Singapore and Helsinki, have created open data web portals that make selected data generated by city services available to anyone free of charge, including application and service developers. For example, San Francisco's online open data depository provides a platform that third parties have used to create apps and services, such as a map of privately owned, but publicly accessible, spaces in the city and a service that shows people where they can recycle, reuse or compost specific products and materials.

[20] Source: 'South Korea: Busan Green u-City Smart City Builds on Cloud Services Delivered by Public-Private-Partnership', GSMA Connected Living Programme.

Private sector use of public data can generate substantial value. Denmark, for example, estimated that the business reuse of public data could amount to more than €80 million per year, while the social benefits would amount to about €14 million. Seventy percent of this benefit was estimated to come from the private sector.[21]

In this model, the objective for cities and governments is not to generate revenue from the public data collected via their smart city project; instead, the goal is to provide a platform with the right governance structures that encourages the use of the data to create new jobs, drive costs down, generate significant benefits for citizens and promote digital businesses within their cities.

2.2.3.3 Pilot Projects

Vendors or solution providers might be willing to provide technology for early projects in order to use certain smart cities as reference accounts. Examples include:

- The Smarter Cities Challenge, launched in 2011, is a competitive grant programme awarding $50 million worth of IBM expertise over three years to 100 cities around the globe.
- Vodafone and IBM shared the cost of the Istanbul in Motion pilot, which is a project that aims to make public transport in the city more efficient and cost effective.

There are also a number of government support schemes, which may assist innovative businesses to start up or to demonstrate and deploy smart city innovations. For example,

- In 2012, the Australian government committed up to AUD 100 million (circa USD 91 million) to develop a smart grid, a smart city demonstration project in partnership with industry.
- In June 2013, the Energy Market Authority of Singapore awarded research grants totalling about SGD 10 million (circa USD 8 million) for 6 pilot projects on smart grid technologies.
- In 2011 and 2012, China's Ministry of Science and Technology initiated two batches of ICT and smart city projects under the National 863 Plan, with the objective of supporting R&D in key smart city technologies, for example, the comprehensive technical solutions for the system interconnection of city operation and service application, data sharing of different systems, real-time high-quality analysis, real-time show technology, etc.
- In 2013, MOHURD cooperated with the China Development Bank and issued the pilot projects of smart city; the line of credit might reached 80 billion RMB.

[21] Source: page 34, ' Information Marketplaces: The New Economics of Cities', the Climate Group | Arup | Accenture | Horizon|.

2.2.3.4 Smarter Procurement

City authorities and property developers spend vast sums of money on smart city infrastructure and services but the scoring systems for the procurement of these items are often based on traditional systems, which create no incentive for the suppliers to offer innovative solutions. However, there is now a trend among policymakers to implement more creative and innovative approaches to procurement of city services so as to encourage service providers to offer 'smarter' solutions. For example, some cities are now specifying outcome-based procurement criteria such as lowering congestion or carbon impact in traffic systems and/or introducing more open criteria to incentivise suppliers to provide more innovative and creative smart city solutions.

An example of a city that has engaged smartly with its supplier is the City of Evansville, USA, which negotiated a performance-based contract with its supplier Johnson Controls on their Smart City 2.0 Initiative. The project includes the replacement and automation of the city's water meters that use wireless meter reading technology, improvements to water/wastewater treatment systems and harnessing renewable energy at those treatment plants. Smarter procurement has enabled the city to use a portion of the guaranteed savings made to pay for the project itself without rate increases to the residents of Evansville.[22]

2.2.4 Smart City Services

There are many types of smart city services which have been deployed across the globe to address the problems and development priorities of cities, for example:

- *Smart traffic systems* which use data from sensors to proactively reroute traffic to avoid congestion and maximise road utilisation
- *Smart grid technology* which enables end users to be more efficient with their energy uses and allows utility companies to proactively identify and repair energy or water leakage
- *Public safety and security* systems that measure real-time people movement that can be used to alert police or transport networks
- *Smart health solutions* which remotely monitor chronically ill patients so they can remain longer at home and reduce the pressure on resource-constraint public hospitals
- *Smart learning solutions* such as virtual classrooms and new learning environments that improve student outcomes, increase efficiency and enhance safety and security

[22] Source: City & JCI Agree to Final Terms of Smart City 2.0 Initiative; http://www.evansville.in.gov/index.aspx?page=9&recordid=1558&returnURL=%2Findex.aspx%3Fpage%3D60.

Data from the GSMA's Connected Living Tracker, a public database of trial and commercial smart city projects with the involvement of mobile operators (see Fig. 2.4) and 'Toward a framework for Smart Cities: A Comparison of Seoul, San Francisco and Amsterdam' (see Fig. 2.5), provides an indication of the range and distribution of smart city services that have been deployed/are being implemented around the globe.

As can be seen there are a large number of smart energy/environmental and transport projects, which is hardly surprising given that the environment and

Category	Percentage of projects
Transport: includes public transport, intelligent transport systems and parking	39%
Environment/Energy: includes energy-efficient buildings	37%
Municipal projects: includes waste management, modernisation of water systems, smart lighting systems, public safety and city resilience programmes	19%
Economic stimulus and open data	5%

Fig. 2.4 Global smart city services with mobile operator involvement – 2013

Category	Percentage of service (by category)		
	Seoul	San Francisco	Amsterdam
Crime/Disaster Prevention	9%	17%	2%
Environment	5%	15%	19%
Education	2%	-	2%
Public Administration	13%	12%	22%
Facility Management	14%	3%	2%
Job Creation/Business	3%	3%	4%
Tourism/Culture/Sports/ Leisure	22%	15%	26%
Transport	20%	35%	15%
Medical Welfare/Health	8%	-	4%
Other	3%	-	4%

Fig. 2.5 Smart city services in Seoul, San Francisco and Amsterdam – 2012

transportation are the most frequently identified challenge areas for cities. Municipal governments are therefore using ICT as an enabler to

- Use energy more efficiently both to reduce their costs and to improve the environment both directly through lower pollution and indirectly through lower greenhouse gas emissions
- Encourage the use of public transport by providing sufficient number of buses, trains and mass rapid transport systems to ease congestion by reducing the number of private vehicles on the road and reducing the time it takes citizens to get to and from their place of work

Although open data and economic stimulus projects are fairly small in number, they are likely to increase as more cities see the benefits of capturing data and make it available to the private sector to develop innovative new services to drive economic growth.

Annex 1, provides a range of examples and case studies of smart city projects, which have been deployed around the world.

2.2.5 Technology

This section of the report explores the technologies that are both driving the increasing supply of urban data and those that are enabling opportunities from the data to be realised to generate innovative smart city services, namely:

- Broadband connectivity
- Internet of Things/Internet of Everything
- Smart personal devices
- Cloud computing
- Big data analytics

Also included in this section is an overview of the global technology companies that are offering smart city solutions. Finally to complete the picture, a summary of the evolving technology standards for smart city technology solutions is provided.

2.2.5.1 Broadband Connectivity

Broadband, ubiquitous and convergence are the global trend in ICT infrastructure. Transporting the vast volume of data created by such things as utility meters in smart grids, traffic information sensors in roadside infrastructure and micropayment data in mass rapid transport systems requires high-capacity ubiquitous fixed (e.g. cable, xDSL, FTTx) or wireless (e.g. LTE, Wi-Fi, WiMaX) broadband networks. Most cities in the developed world already have broadband infrastructure, albeit in some cases bandwidth is constrained due to the underlying technology. In

comparison, in cities in poorer developing countries, there has been limited investment in broadband infrastructure.

Investment in broadband networks is likely to increase as demand grows throughout the urban world. Governments are realising that broadband networks are vital to national competitiveness and are a key enabler of delivery of public services (see Sect. 2.2.7, Government Policies).

2.2.5.2 Internet of Things/Internet of Everything

IoT is a new infrastructure which expands the services and applications provided by the present communication networks and the Internet. Sensing and identifying the physical world by utilising sensor technologies and intelligent devices, IoT through transmission and interconnection of networks performs computing, processing and knowledge mining, in such a way as to realise information interaction and seamless interaction between human and objects as well as between objects, thereby serving the purposes of real-time control, accurate management and scientific decision-making of the physical world.[23] It encompasses various identification, sensing and communication technologies such as radio frequency identification (RFID), wireless sensor networks, actuators, near-field communication (NFC), ZigBee and Bluetooth.

IoT solutions are deployed in sectors including automotive, transportation, smart homes, energy, utility, security, surveillance, public safety, financial services, retail, healthcare, industrial, warehousing and distribution. Sometimes IoT is used synonymously with the term machine to machine (M2M).

M2M market grows rapidly in recent years. By the end of 2013, the M2M connection reached 195 million; the yearly compound rate reached 38 %. The ratio of M2M connection in all mobile connection increased from 1.4 % in 2010 to 2.8 % in 2013,[24] and it is estimated that the global M2M connection will reach 25 million by the end of 2014.

2.2.5.3 Smart Personal Devices

Circa five billion people have access to mobile phones and more than one billion of these are smartphones, and based on current growth rates, this is likely to reach 4.5 billion by 2018.[25] Smart devices have considerable computing power and are capable of generating vast amounts of data that can be used to generate smart city solutions. For example, Google Maps and its traffic data app provide the user with a map

[23] *The White Paper on the Internet of Things*, 2011. China Academy of Telecommunication Research of MIIT 2011.

[24] *GSMA, From concept to delivery: the M2M market today*, February 2014.

[25] Source: Patrick Cerwall, director, Strategic Marketing and Intelligence, Ericsson, July 2013 http://www.lafabriquedelacite.com/en/speech/which-could-be-impacts-ntic-urban-life.

of the city and a representation of the traffic flow. However, Google is able to get a better real-time picture of traffic flow by using a crowdsourcing model where people's smartphones become sensors. Smartphone locations are tracked by cell-phone companies, which gives a measure of how traffic is. As a result, the same people who are using Google's map application may also be sending Google traffic data to inform the map and hence improve the accuracy of the traffic flow.

2.2.5.4 Cloud Computing

Cities need to collaborate and share information across public and private communities, and cloud-based city services may help cities achieve this objective. Cities that make use of cloud-based services, which are paid for on a pay-as-you-go basis, may also be more cost effective than owning dedicated infrastructure. Cloud computing is also likely to drive innovation in new smart city services by providing the computing capabilities to data mine and analyse the large public data repositories and personal data from smart connected devices.

In addition to reducing costs, cloud-based smart city services are likely to be more efficient than city owned data centres. A report published by Microsoft Europe and the Global e-Sustainability Initiative (GeSI) predicts that more than USD two billion in energy savings could be achieved if 80 % of public and private organisations in 11 countries switched to cloud-based email and other software solutions.[26]

However, some local governments are concerned about the implications of cloud-based services for citizen privacy and data ownership. Cities will need to develop a strategy, in conjunction with their cloud service provider, to consider the legal and jurisdictional issues of data privacy and security (see Sect. 2.2.7, Government Policies).

2.2.5.5 Big Data Analytics

Data sharing mechanisms such as open Application Programming Interfaces (APIs) have played an important role in encouraging the application development community to develop innovative new smart city services. According to the report 'Information Marketplaces: The New Economics of Cities', there has been an explosion of open API developer interfaces since 2005, rising from approximately 235 publically available open APIs in 2005 to just under 6700 in 2011 (Fig. 2.6).[27]

By compiling volumes of existing data into one place, governments provide the platform for businesses and individuals to develop new services and solutions. Advances in computing and analytics enable developers from both the public and

[26] Source: http://www.greenbiz.com/blog/2013/07/01/icymi-what-will-smart-city-look-2050.

[27] Source: page 35, 'Information Marketplaces: The New Economics of Cities', the Climate Group | Arup | Accenture | Horizon|.

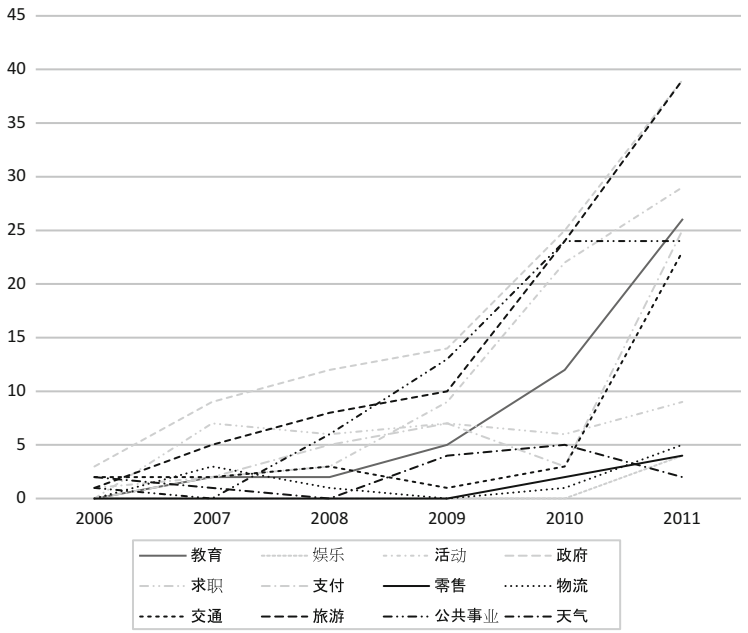

Fig. 2.6 Rates of change in open APIs associated with city infrastructure (Source: page 35, 'Information Marketplaces: The New Economics of Cities', the Climate Group | Arup | Accenture | Horizonl)

private sectors to transform this 'big data' into new applications that were not possible due to data being locked in separate silos. For example, New York City's data analysts recently found correlations between geospatial sewer data and health department inspection information that led to a 95 % success rate in tracking down restaurants that were illegally dumping grease and clogging up the sewer lines.[28] Police departments in Santa Cruz and Los Angeles have been using an application call PredPol, which uses predictive algorithms to anticipate future crime hotspots and pre-emptively deploy officers to the location.[29]

2.2.5.6 Smart City Technology Solution Providers

There are many global technology players providing smart city solutions, each with different strengths and weaknesses. It is beyond the scope of this report to provide an assessment of these players. However, as a guide as to who are the key players in the market, a recent report from Navigant Research[30] provides an assessment of the strategy and execution of 15 global smart city solution providers (Fig. 2.7).

[28] Source: http://www.nytimes.com/2013/03/24/nyregion/mayor-bloombergs-geek-quad.html?pagewanted=all&_r=1&.

[29] Source: http://datasmart.ash.harvard.edu/news/article/to-catch-a-sniper-132.

[30] 'Navigant Research Leaderboard Report: Smart City Suppliers', July 20013.

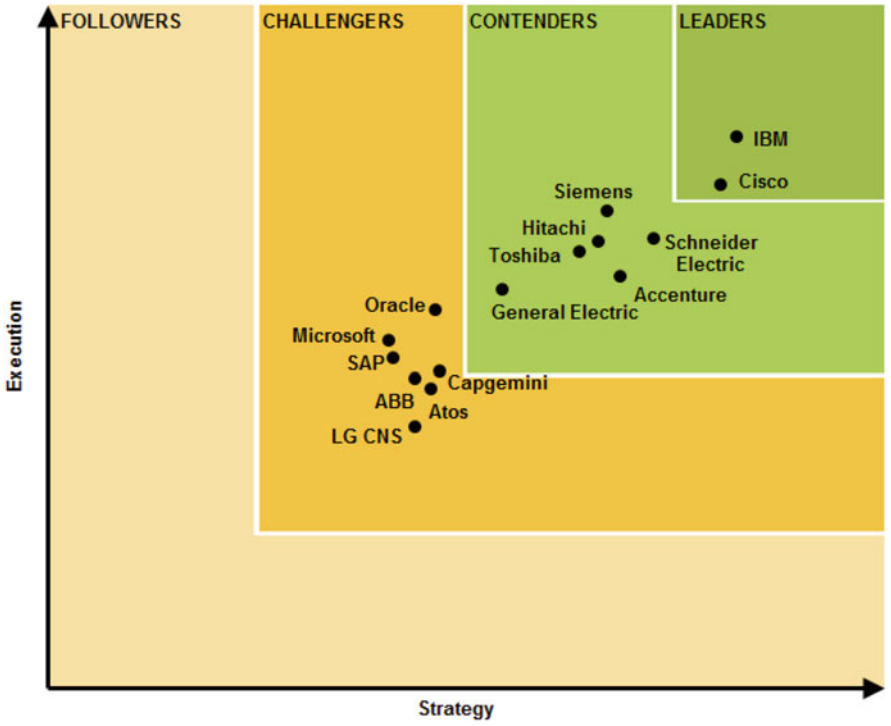

Fig. 2.7 Assessment of strategy and execution for 15 smart city technology solution providers (Source: http://www.navigantresearch.com/research/navigant-research-leaderboard-report-smart-city-suppliers)

In addition to the large technology players, evaluated by Navigant Research, there are many thousands of technology companies developing and implementing smart city solutions. For example, China Mobile, China Telecom, Datang, Huawei[31] and ZTE have developed a range of smart city solutions. However, to date, no one player has all the technology capabilities required to deliver the range of smart city solutions. Typically this has led to technology players forming partnerships/collaborations on a project-by-project basis.

Huawei uses its dedicated 'cloud-pipe-device' architecture to develop smart city solutions that consist of the following parts:

- Network infrastructure: enables ubiquitous broadband access
- Unified cloud data centre platform: allows efficient data sharing
- Comprehensive UC&C products and solutions: supports the development of public applications.

[31] Huawei positively invested in the smart city areas and made great achievements, it has been involved in the smart city planning and construction in more than 100 cities in more than 20 countries and gained the F&S *Digital City solution innovation award* and *the outstanding provider of China City informationalization.*

Huawei's smart city solution uses multiple cutting-edge technologies to gain technological advantages:

DCDC

DCDC integrates Huawei-developed servers, storage units and cloud computing products, as well as heterogeneous IT resources. This next-generation data centre solution provides standard, agile and flexible upper-layer applications to enable data centre as a service (DCaaS), allowing cross region collaboration using easy-to-use IT systems.

eLTE

Huawei uses advanced wireless technologies to provide the eLTE broadband trunking and access solutions. These solutions offer diverse services, such as dedicated broadband trunking, video surveillance, data collection, broadband data access and emergency communication. These services help cities improve operational efficiency, deploy networks in harsh environments, protect public security and enrich people's lives.

Agile Network

The agile network is developed based on the software-defined network (SDN) and three major architecture innovations (programmable, quality awareness and smooth evolution). This next-generation network solution provides quick and flexible services for cities to improve the industry innovation speed for four times and to gain competitive edges in the international market (Fig. 2.8).

2.2.5.7 Technology Standards

Many standardisation development organisations have initiated standardisation work for smart cities. A summary of the status of smart city technical standards is given below in Fig. 2.9.

In addition to the technical standards for smart cities, there are several supporting standards that are being developed for smart cities, for example:

- In April 2012 the UK Department of Business, Innovation and Skills commissioned British Standards Institute (BSI) to develop a standards strategy for smart cities. The strategy outlines a foundation of knowledge and will include guide-

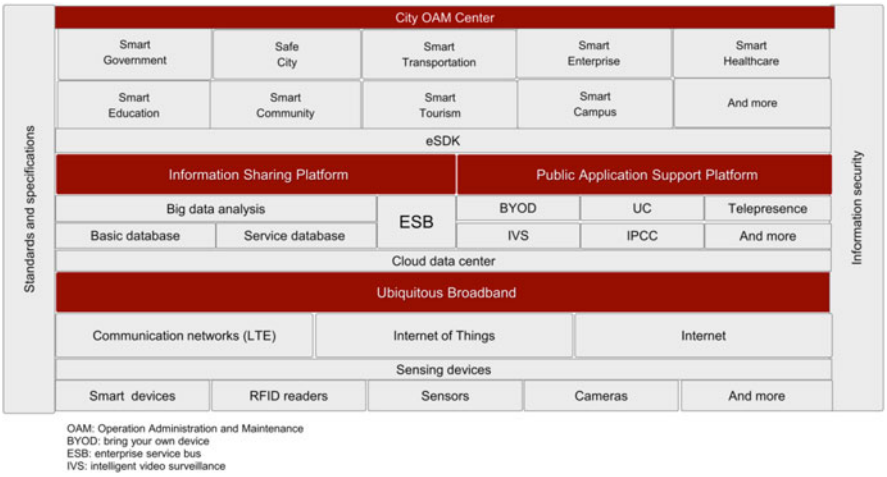

Fig. 2.8 Huawei smart city solution

lines, metrics, management processes and technical specifications.[32] In February 2014, BSI published 'The smart city framework' (SCF), which is a guide intended for use by leaders, at all levels and from all sectors, of smart city programmes. It provides practical, 'how-to' advice, reflecting current good practice as identified by a broad range of public, private and voluntary sector practitioners engaged in facilitating UK smart cities.

- The Institute for Transportation and Development Policy (ITDP) has developed the transit-oriented development (TOD) standard, which was published in June 2013. The standard draws on international expertise to come to a common understanding of what constitutes urban development best practice in promoting sustainable urban transport. This includes minimising the use of personal motor vehicles and reducing greenhouse gas (GHG) emissions and other negative externalities associated with their use.[33]
- In China, several national standardisation committees and consortia have started standardisation work on smart cities, including China National IT Standardisation TC (NITS), 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 and China Strategic Alliance of Smart City Industrial Technology Innovation.[34]

[32] 'Preparing the way for smart cities' BSI; http://www.bsigroup.com/Documents/standards/case-studies/BSI-supporting-innovation-smart-cities-case-studies-UK-EN.pdf.

[33] Source: TOD standard, printed June 2013, ITDP.

[34] Source: 'CESI contribution on possible work on Smart Cities in JTC 1', May 28 2013, http://isotc.iso.org/livelink/livelink/open/jtc1swg3.

Organisation	Standard
ETSI	■ Many technical activities of ETSI www.etsi.org/standards are linked directly to the concept of "smart cities", e.g. mobility, transportation, M2M, energy efficiency, security, etc. ■ ETSI organised 2 events in 2013 gathering multiple players involved in Smart Cities. The purpose of these events was to define the driving expectations from an ICT standards organization with regards to smart cities. ■ In October 2013 the ETSI board agreed on the following roadmap for Smart Cities o Define a High Level Architecture for smart city from the ICT perspective o Initial in-house standards inventory: main technical areas and all ETSI specifications that may be applied in a smart city o Identify pertinent players outside ETSI and plan for outreach. This includes National Standard Organisations. o Prepare « ICT standards for smart cities » work-plan with partners.
IETF	■ IPv6 and 6LoWPAN networking ■ Routing algorithms (e.g. RPL) ■ Web of Things (REST for IoT, CoAP, Resource Directory etc.) ■ Security (DTLS, TLS, Cipher suites)
ISO	■ ISO Technical Committee 268, Sustainable development incommunities, focuses on the development of a management system standard. ISO/TC 268/ SC 1, Smart community infrastructures, is dedicated to smart urban infrastructures. o ISO 37101, Sustainable development and resilience of communities – Management systems–General principles and requirements o ISO 37120, Sustainable development and resilience of communities – Global city indicators for city services and quality of life o ISO/TR 37150, a technical report on smart urban infrastructures around the world o ISO 37151 standard on harmonized metrics for benchmarking smartness of infrastructures ■ A joint working group (JWG) helps coordinate common areas between ISO/TC 205, Building environment design, and ISO/TC 163, Thermal performance and energy use in the built environment, and has developed a holistic approach to address buildings' energy performance. The JWG has started work on a standard for addressing the indoor environmental conditions assumed in energy performance calculations. ■ ISO/TC 204, Intelligent transport systems, focuses on standardization of information, communication and control systems in the field of urban and rural surface transportation, including intermodal and multimodal aspects thereof, traveller information, traffic management, public transport, commercial

Fig. 2.9 Emerging smart city technical standards

	transport, emergency services and commercial services in the intelligent transport systems (ITS) field. ■ Other Working Groups (WG) and sub-committees (SC) developing technical standards include: o WG on Infrastructures of sensor network e.g. ISO/IEC DIS 29182-1 Information technology – Sensor networks: Sensor network reference architecture o WG on Governance of IT which incorporates the mechanisms, methods, and models which ensure the conformance of IT to underlying and required policies, regulations, laws, and ethical guidelines. o SC on Telecommunications and information exchange between systems
ITU-T	■ ITU-T has established a new Focus Group on Smart Sustainable Cities to assess the standardisation requirements of cities aiming to boost their social, economic and environmental sustainability through the integration of ICTs in their infrastructures and operations.
OneM2M	■ Ongoing work on M2M system standardization (CoAP, HTTP binding). The goal of oneM2M (/www.onem2m.org) is to develop technical specifications which address the need for a common M2M Service Layer that can be readily embedded within various hardware and software, and relied upon to devices in the field with M2M application servers worldwide.
The Internet of Things and RFID Standards Database	■ Provides up-to-date information on standards relevant to RFID and the emerging IoTwww.iotstandards.org.
ZigBee & WiSun	■ ZigBee IP - An open-standard 6LoWPAN stack for Home Area Networks ■ ZigBee IP NAN – 6LoWPAN stack for Sub-GHz large area applications ■ WiSun - Sub-GHz 802.15.4g/e and 6LoWPAN consortium

Fig. 2.9 (continued)

There are many standards-related initiatives in the smart city ecosystem. Some standards are at an early stage of development and others are focused on a narrow scope of work that may not always have a global perspective. As a result there is a risk that smart city solutions deployed today may need to be replaced to ensure they are interoperable with future systems.

Further innovation and cooperation between standard bodies, technology vendors and network providers are required to ensure that smart city ICT infrastructure is based on open, interoperable and vendor-neutral standards.

2.2.6 Smart City Communities

Communities of interest have established alliances to enable better understanding and collaboration among stakeholders involved in developing building smarter cities. Figure 2.10 provides a sample of some of the global initiatives.

2.2.7 Government Policies

Government policies play a role in driving smart city technology developments. For example, governments, particularly in East Asia, are supporting smart city pilots and positioning their industrial champions at the heart of the smart city agenda, with the intention of generating a 'smart infrastructure' export market.

In Japan, the Ministry of Economy, Trade and Industry has a programme underway with companies, such as Panasonic, Hitachi, Toshiba and others, to develop smart city services that can be tested in four domestic pilot cities and sold internationally – Japanese companies are actively participating in projects in the USA, France, Spain, India and China. Similar strategies are being followed in Korea.

As broadband networks and cloud computing are key components of smart cities, government policies towards the legal and regulatory framework for the development of this infrastructure may also help to support (or hinder) the growth of smart cities.

2.2.7.1 National Broadband Plans

In the recent report 'Planning for Progress: Why National Broadband Plans Matter'[35], data indicates that countries with a national broadband plan have fixed broadband penetration 8.7 % higher on average than countries without plans (Fig. 2.11).

Once the potential impact of factors like higher average income per capita, market concentration and urbanisation are discounted, research suggests that countries with plans benefit from fixed broadband penetration on average 2.5 % higher than countries without plans. In mobile, the impact may be even greater; countries which have national broadband plans also have mobile broadband penetration some 7.4 % higher on average than countries without plans.

[35] 'Planning for Progress: Why National Broadband Plans Matter', ITU, the Broadband Commission for Digital Development and Cisco, July 2013.

Organisation	Role
City Protocol www.cityprotocol.org	■ An international association of cities, commercial and non-profit organizations, universities and research institutions whose role is to develop the City Protocol, i.e., a system's approach to rationalize and document city transformation. Influenced in part by Internet standards bodies, namely the Internet Engineering Task Force (IETF), the Internet Society (ISOC), and the World Wide WebConsortium (W3C), the organisation seeks to promote new leadership models, citizen engagement, and effectiveapplications of ICT in delivering a process for developing Smart Cities.
Citymart.com (formerly Living Labs Global) www.citymart.com	■ Citymart connects cities and solution providers around the world to improve lives rapidly across cities. The organisation comprises of 50 cities, commercial and non-profit organisations.
The Climate Group www.theclimategroup.org	■ The Climate Group is an independent, not-for-profit organization working with a coalition of companies, states, regions, cities and public figures to inspire and catalyse leadership for a Clean Revolution: a low carbon future that is smarter, better and more prosperous for all.
Metropolis www.metropolis.org	■ Metropolis association is represented by more than 120 members from across the world and operates as an international forum for exploring issues and concerns common to all big cities and metropolitan regions. Metropolis also manages the Metropolitan Section of United Cities and Local Governments (UCLG).
New Cities Foundation (NCF) www.newcitiesfoundation.org	■ NCF is a non-profit Swiss institution dedicated to improving the quality of life and work in the 21st-century global city, with a particular focus on new cities in Asia, the Middle East, Latin America and Africa. NCF serves a unique role in developing new models of collaboration between the public, private and academic sectors.
Smart City council (SMC) www.smartcitiescouncil.com	■ The SMC is an industry coalition formed to accelerate the move to smart, sustainable cities. Partners include leading technology companies. The Advisory Board includes leading universities, research institutes, national laboratories, development banks, and standards organisations. The SMC has published a "Readiness Guide", which is comprehensive, vendor-neutral handbook for city leaders and planners to help them assess their current state of technology and give them a roadmap for developing a smart city.
World e-Governments Organization of Cities and Local Governments (WeGO) www.we-gov.org	■ WeGO is an international organisation committed to accomplishing three goals. It seeks to share and disseminate the knowledge and practices of e-governments around the world; to achieve "green growth" utilizing ICTs, to bridgethe digital divide by providing ICT support to cities in emerging economies, and to improve citizens'quality of life through greater administrative efficiency and transparency.
China Strategic Alliance of Smart City Industrial Technology Innovation www.smartcityunion.cn	■ A non-profit non-governmental organisation comprised of enterprises, colleges and research institutes engaged in areas related to smart city has about 40 members now. The alliance has the following main objectives and tasks: cooperating in common key technologies for smart city, establishing a mechanism to communicate with the government and a platform for international cooperation, and supporting the constructionof technological and standard systems for smart city development in China.
China smart Cities Industry Alliance (CCIT) www.ccit.org.cn	■ A group comprised of about 50 enterprises, public institutions, colleges and research institutes engaged in areas related tosmart city. By setting up a bridge between its members and the city, the alliance aims to enhance the technological innovation capacity of the industry, encourage researches and innovations in smart industry and modern service industry, explore the market for smart city application and formulate industrial standards.

Fig. 2.10 Smart city communities

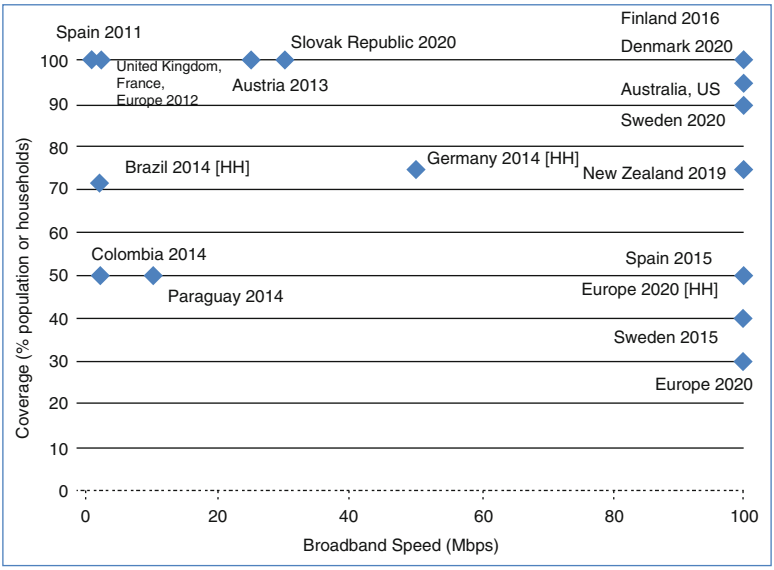

Fig. 2.11 Targets set by national broadband plans (Source: ITU)

2.2.7.2 Cloud Computing

Government public policies on issues such as data privacy and security, cybercrime and IPR protection impact a country's preparedness to support the growth of cloud computing.

The Business Software Alliance (BSA) scorecard examines major laws and regulations relevant to cloud computing in seven policy categories as well as each country's ICT-related infrastructure and broadband deployment. The results from the 2013 survey are given in Fig. 2.12 overleaf.

Developed economies like Japan, the scorecard's top finisher, have laws and regulations that promise to support the development of cloud computing. Emerging economies, such as Vietnam, face several challenges when it comes to fully capitalising on the economic benefits of the cloud.

2.3 Developments in China

The urbanisation process has accelerated in China, particularly during the past 10 years with the urbanisation rate reaching 52.6 % in 2012. Urbanisation is part of China's modernisation process and provides the biggest potential for enlarging the domestic economy. The definition of smart city is a new development idea and coincides with the process of informatisation and urbanisation. Smart city plays a very

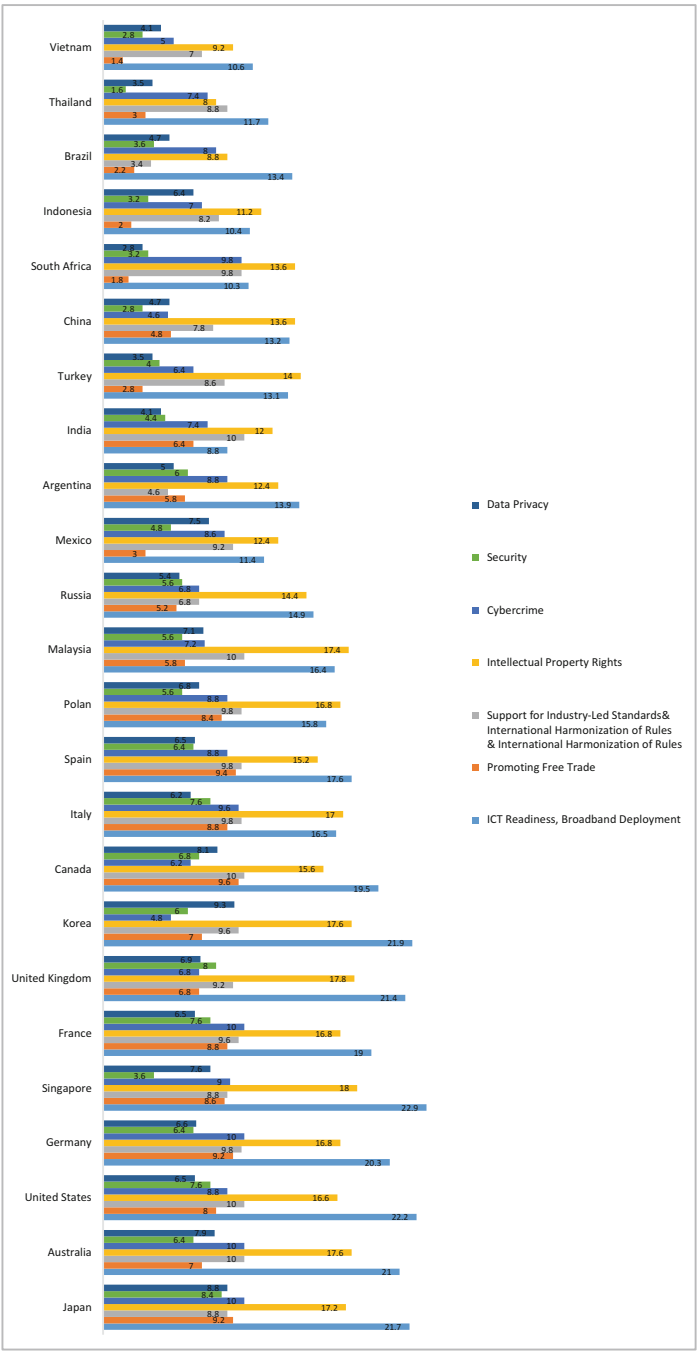

Fig. 2.12 BSA cloud computing scorecard – 2013 (Source: 2013 BSA Global Cloud Computing Scorecard)

significant role for China in developing into a smart, green and low-carbon environment which also helps to increase the happiness of the citizens.

At present, the relevant government departments and various cities in China are positively promoting smart city development. MIIT; the Ministry of Science and Technology ('MOST'); the Ministry of Housing and Urban-Rural Development ('MOHURD'); the National Administration of Surveying, Mapping and Geoinformation; the National Tourism Administration; and other departments have carried out relevant work from the aspects of technical research and development, standard formation and pilot demonstration.

As of September 2013, a total of 311 cities in China have proposed or are embarking on smart city development, including all cities above the sub-provincial level, 89 % cities at the prefectural level and above and 47 % cities at the county level and above.[36] During the 'Twelfth Five-Year Plan' period, the plan investment in Chinese smart cities is expected to be more than 1.6 trillion yuan.[37]

Various organisations are involved in the development of smart cities in China, including government ministries, commissions and local governments.

2.3.1 Government Ministries and Commissions

A summary of the key smart city developments undertaken by government ministries and commissions in China is provided below.

- MIIT, the people's government of Zhejiang Province and the National Standards Commission have jointly signed the *Strategic Cooperation Framework Agreement on Jointly Promoting In-depth Integration of Informatization and Industrialization and 'Smart City' Development Pilot Project in Zhejiang Province*. Yangzhou City and Changzhou City in Jiangsu Province were awarded by MIIT as the first batch of pilot cities for smart city development in China.
- Recently, MIIT launched the EU-China green smart city cooperation project under the framework of the EU-China ministerial-level dialogue.
- MOHURD printed and issued *the Interim Measures for the Administration of National Smart Cities and the Pilot Index System for National Smart Cities (District and Towns) (for Trial Implementation)* at the end of 2012 and released the two batches of a total of 193 pilot smart city development projects in January and August 2013, respectively, involving 171 cities, which greatly promoted the process of smart city development in China.[38]

[36] The structural hierarchy of the administrative divisions of the People's Republic of China comprises 5 levels: provincial, prefecture, county, township and village.

[37] *Report on Study of the Progress and Problems of Smart City Development in China*, CATR, 2013.

[38] MOHURD, http://www.mohurd.gov.cn/zxydt/201308/t20130808_214670.html.

- The Ministry of Science and Technology, based on the Smart City Development Project Phase I of the National Programme 863, initiated in March this year the Smart City Development Project Phase II in the field of information technology, established the Chinese independent smart city technology and standard system and carried out research on common and key technologies and public service demonstration applications. The Ministry of Science and Technology and the National Standard Commission have also jointly selected 20 cities for pilot demonstration of 'smart city' technologies and standards.
- The National Tourism Administration launched two batches of pilot smart tourist projects in 2012 and 2013, respectively, and selected 18 and 15 cities as 'National Pilot Smart Tourism Cities', respectively.

2.3.2 Smart City Developments

A report on the 'Study of the Progress and Problems of Smart City Development in China',[39] conducted by the China Academy of Information and Communications Technology ('CAICT'), in 2013 revealed that there are many smart city projects spread throughout China. The key findings from the report are provided below.

- The 4 municipalities directly under the central government, 15 sub-provincial-level cities, 241 prefecture-level cities and 51 county-level cities have proposed or are embarking on smart city developments. There are 311 smart cities, accounting for 47 % of the cities at the county level and above. In these cities, there are 52 cities at the prefecture level and above that have formally proposed smart city development in the government work report of 2013 and the Twelfth 5-Year Plan for National Economic and Social Development.
- Twenty-three cities have officially released their relevant special plans or action plans for smart city development, including Beijing, Guangzhou, Tianjin, Shanghai, Nanjing, Shenzhen, Jiaxing, Ningbo, Suzhou, Yangzhou, Hangzhou, Foshan, Shanwei, Wuhan, Changsha, Zhuzhou, Xiangtan, Xinxiang, Yunfu, Guyuan, Liaoyuan, Xiaogan and Shiyan. The two batches of a total of 193 pilot cities (districts, counties and towns) approved by MOHURD have all formulated their smart city development and implementation plans.
- Smart cities range from medium- and large-sized cities to small- and medium-sized cities and in some cases towns. There are a total of 51 county-level cities that have proposed smart city development, and these cities are mostly county-level cities in the eastern coastal provinces, including 9 in Guangdong, 6 in Fujian and 5 in Shandong, respectively. Among the first batch of 90 national pilot smart cities approved by MOHURD, there are 6 counties and towns; among the second batch of 103 pilot smart cities, there are 20 counties and towns. The

[39] *Report on Study of the Progress and Problems of Smart City Development in China*, CATR, 2013.

scope of study and practice of smart cities has also extended to provincial-level city clusters.

- The design and layout of smart cities have been carried out from the perspective of overall provincial planning. For example, Jiangsu, Shandong and Fujian have proposed the idea of smart city clusters, and Zhejiang has selected 13 prefecture-level cities for characteristic application pilot demonstration according to their characteristics so as to give play to the differentiation advantages and jointly push forwards the construction of 'Smart Zhejiang'.
- Smart cities are still mainly concentrated in the eastern and central regions in China largely due to their higher level of economic development and more advanced use of information technology. Eighty-two cities at the prefecture level and above and 52 districts, counties and towns in the 9 provinces in Eastern China have proposed smart city development. All the prefecture-level cities in Jiangsu, Zhejiang and Fujian have proposed or are embarking on smart city development, and 88 % and 57 % of the prefecture-level cities in Shandong and Liaoning have proposed smart city development. Among the prefecture-level cities in Eastern China that have proposed smart city development, over a half of the cities have a GDP per capita of more than USD 8000.

One hundred and nine prefecture-level cities in the ten provinces in Central China have proposed smart city developments, accounting for 80 % of all prefecture-level cities in Central China.

Sixty-four prefecture-level cities in the twelve provinces in Western China have proposed smart city developments, accounting for 76 % of all prefecture-level cities in Western China.

- Greenfield smart cities in China have distinct advantages compared with brownfield smart city development. For example, greenfield smart city construction and municipal facility and land-use planning can be implemented synchronously. This is a breakthrough point and an experimental field for a city with huge functions and complicated operations. Therefore, greenfield smart districts have become a new hotspot in the smart city development practice throughout China. More than 47 cities proposed smart city development based on their new urban districts in 2012. Among the two batches of national pilot smart cities released by MOHURD, there are 15 new urban districts. With the acceleration of the urbanisation process, all new cities will be developed as a smart city.
- Smart parks, characterised by city-industry integration, are a growing trend in China. Smart parks, comprising industrial and technology parks, drive local economic development through the clustering of leading industrial enterprises and corporations. Encouraging high-end industrial parks, business districts and technology parks to carry out smart operation and achieve city-industry integration is a prominent feature of the current smart city development. Among the two batches of national pilot smart cities released by MOHURD, there are a total of twelve industrial or business districts, and these industrial districts, high-tech parks and business districts are mostly in the eastern regions. The coordinated development of smart cities and industrial function zones is a new concept of urban development in China.

2.4 Developments in the EU

Although the speed of urbanisation in the EU is currently nowhere near as rapid as in China or other Asian growth regions, three quarters of Europeans (circa 350 million people) live in urban agglomerations of more than 5,000 inhabitants. The urban population is continuing to grow and is already consuming 70 % of the EU's energy. Congestion costs Europe about 1 % of its GDP every year; most of it is located in urban areas.[40] Europe's urban structure is not very concentrated: twenty-three cities are populated by more than one million citizens, 345 cities by more than 100,000 and only 7 % of the EU population live in cities of over 5 million. Fifty six percent of the European urban population (circa 38 % of the European population) lives in small- and medium-sized cities and towns of between 5,000 and 100,000 inhabitants. These small- and medium-sized cities are considered to

> …constitute the building blocks of urban regions and lend character and distinctiveness to their regional landscapes. (…) The generic features of small and medium-sized cities – particularly their human scale, liveability, the conviviality of their neighbourhoods, and their geographical embeddedness and historical character – in many ways constitute an ideal of sustainable urbanism.[41]

Still, the growth and development of cities in Europe pose a major problem for sustained and sustainable development as cities produce the most waste, are responsible for most energy consumption and feature issues such as segregation and unemployment. At the same time European cities are seen to provide a source for solutions. For example, cities tend to be populated by a larger density of highly educated citizens and are more innovative through the bundling of talent. The high density of citizens – and hence challenges – produces more pressure on finding solutions for problems such as provisions of public services, healthcare and education and solutions for maintaining a clean environment.

Because of these observations, there is an abundance of initiatives and measures in place seeking to support cities in their efforts to tackle the urbanisation challenges and in particular address the environmental and energy impact cities have. The main effort comes from the cities themselves, local and municipal decision-making being mostly autonomous with respect to the way a city manages its resources and services.

For the purpose of this EU-China cooperation, it was considered important to refer to examples of small- and large-scale smart city initiatives where EU and non-EU European cities share their experiences and engage in joint problem-solving and where these experiences can serve as relevant source for other cities anywhere around the globe that seek to engage in similar ventures. A summary of European smart city projects and programmes to coordinate the cities' efforts is given in Annex 3 of this report.

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[40] http://europa.eu/rapid/press-release_IP-12-760_en.htm.

[41] http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/citiesoftomorrow/citiesoftomorrow_final.pdf. An overview on the EU's urban development activities under the 'Cities of Tomorrow' headline can be found there.

Chapter 3
EU-China Policy Framework

The EU and China are involved in a number of cooperation projects that have some links to smart city initiatives, for example:

- The EU-China Urbanisation Partnership and the EU-China Mayors Forum
- The EU-China Environmental Governance Programme
- The EU-China Sustainable Urbanisation Park
- URBACHINA
- EC-Link

A description of these and other relevant projects is given in Annex 2: EU-China cooperation facilities relevant to smart city projects.

3.1 Chinese Policy Framework for Smart City Development

This section of the report provides the current policies and regulations of smart city development in China.

In August 2013, China's State Council issued *Several Opinions on Promoting Consumer Spending on Information Technology and Expanding Domestic Demand* (hereinafter referred to as *Opinions*), which clearly proposes to develop pilot and demonstrative smart cities where conditions permit.[1] The *Opinions* require all pilot cities to issue policies to encourage market-based investment and financing, information system service outsourcing and socialised development and utilisation of information resources. The *Opinions* support intelligent upgrading of public utilities and the acceleration of the implementation of smart grids, smart transport, smart water supplies, smart land administration and smart logistics. It encourages market

[1] Several Opinions on Promoting Consumer Spending on Information Technology and Expanding Domestic Demand, http://www.miit.gov.cn/n11293472/n11293877/n15578381/n15578441/15578731.html.

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_3

players to jointly participate in smart city development. Within the amount of local treasury bonds approved by the State Council, the people's government of all provinces, autonomous regions and municipalities directly under the central government will consider arranging some funds for construction of smart cities. Also, it encourages eligible enterprises to issue corporate bonds to raise funds for smart city development. In the same month, the State Council issued the *Broadband China Strategy and Its Implementation Plan* to provide network infrastructure support for smart cities.[2]

MIIT, the National Development and Reform Commission (NDRC), MOHURD and other departments have introduced the relevant regulations to standardise smart city development and are described below.

3.1.1 MIIT

In June 2012, the State Council issued *Several Opinions of the State Council on Vigorously Advancing Informatization Development and Thoroughly Ensuring Information Security*, which proposes to:

- Improve the levels of informatisation in social management and urban operation
- Establish a full-coverage integrated information system for social management
- Promote urban management information sharing
- Popularise the grid management model
- Accelerate the implementation of pilot demonstration for smart grids and smart transport
- Guide the healthy development of smart city development[3]

Since 2011, MIIT has formulated a number of plans associated with smart city development, including:

- The 12th Five-Year Plan for the Development of Information Security Industry
- The 12th Five-Year Plan for the Development of Internet of Things
- The 12th Five-Year Plan for the Development of E-commerce

The 12th Five-Year Plan for the Development of Internet of Things mainly formulated by MIIT supports the application of demonstration projects in key areas, specifically including smart industries, smart agriculture, smart logistics, smart transport, smart grids, smart environment protection, smart security, smart medical care and smart homes.[4] In addition, MITT issued in 2013 the *Special Action Plan*

[2] Notice of the State Council on printing and issuing the 'Broadband China Strategy and Its Implementation Plan' http://www.miit.gov.cn/n11293472/n11293877/n15432927/n15432975/15595937.html.

[3] *Several Opinions of the State Council on Vigorously Advancing Informatization and Thoroughly Ensuring Information Security*, http://www.gov.cn/zwgk/2012-07/17/content_2184979.html.

[4] *The 12th Five-Year Plan for the Development of Internet of Things*, http://www.miit.gov.cn/n11293472/n11293832/n11294072/n11302450/14457095.html.

for In-depth Integration of Informatization and Industrialization (2013–2018),[5] which proposes 8 actions, including the action to improve the level of intelligence in key fields and areas such as e-commerce, logistics, manufacturing, etc., and the action to cultivate smart manufacturing and production models. These key areas are components of a smart city and will provide a solid foundation for smart city development.

3.1.2 NDRC

NDRC and MIIT, together with the Ministry of Science and Technology, the Ministry of Public Security, the Ministry of Finance, the Ministry of Land and Resources, MOHURD and the Ministry of Transport, are studying to draft *Guiding Opinions on Promoting the Healthy Development of Smart Cities* (hereinafter referred to as *Opinions*), which is to be submitted to the State Council for promulgation. The Opinions will clearly propose the ideas, principles, main objectives and development priorities for smart city development in China in order to unify thinking, build consensus and gather forces to strengthen guidance for smart city development practice throughout China.

The *Opinions* clearly specify that smart city is a new concept and a new model of urban development as well as a new tool and method to promote the transformation of government functions and social management innovation. A smart city is the product of in-depth integration of a new generation of innovative IT applications and urban transformation and development and requires cities to realise green, low-carbon and sustainable development. Smart city construction helps raise the level of intelligence of urban infrastructures; makes public services more convenient and social management more sophisticated, ecological environment more liveable and industrial systems more optimised; and effectively protects information security. It helps form the long-term mechanism for sustainable urban development, raises the overall quality and level of urban development and promotes synchronous development of industrialisation, IT application, urbanisation and agricultural modernisation.

The *Opinions* propose to start smart transport, smart grids, smart water supplies, smart environmental protection, smart medical care, smart old-age security, smart communities, smart homes, smart education, smart land administration, smart logistics and smart credit systems in order to provide enterprises and residents with more convenient, efficient and low-cost social services. The *Opinions* also propose to select 100 cities of different sizes at different stages of development in the eastern, central and western regions as pilot and demonstrative cities for smart city development. After some experience has been acquired from the pilot and demonstrative cities, China will gradually encourage and support eligible regions to promote smart city development according to local conditions.

[5] *Special Action Plan for In-depth Integration of Informatization and Industrialization* issued by MIIT, http://lhrh.smelz.gov.cn/html/2013/0925/290269.shtml.

3.1.3 MOHURD

The General Office of MOHURD officially released in 2012 the *Notice on Carrying Out National Pilot Smart Cities* and issued the *Interim Measures for the Administration of National Smart Cities and the Pilot Index System for National Smart Cities (District and Towns) (for Trial Implementation)* to start the application for pilot cities. The cities that intend to apply for national pilot smart cities should meet the following conditions:

- The smart city development has been included in the 12th Five-Year Plan for local economic and social development or related special programmes.
- The city has completed the preparation of its smart city development plan.
- The city has established its smart city development funding plan and support channels (e.g. it has been included in the government budget).
- The main responsible person of the responsible subject is responsible for application and organisational management of building national pilot smart cities.[6]

In addition, the Chinese Society for Urban Studies and China Development Bank have signed the *Strategic Cooperation Agreement on the 12th Five-Year Plan for Smart City Development*, which requires that China Development Bank should provide an investment and financing amount of no less than 80 billion yuan in 3 years after the 12th Five-Year Plan period to support smart city development in China. Under the agreement, MOHURD and China Development Bank will promote a new model of urbanisation; the smart city infrastructure and operations services will provide an opportunity to enhance the cooperation among the pilot smart cities in areas such as infrastructure, integrated smart city operating platforms, urban water supply, building energy saving, green buildings and other fields.[7]

3.1.4 National Administration of Surveying, Mapping and Geoinformation

The National Administration of Surveying, Mapping and Geoinformation issued in 2012 *the 12th Five-Year Plan for Mapping and Geographic Information Technology Development*, which proposes the establishment of technical support system for smart city development.[8] In 2013, it issued the *Technical Guidance for Establishing the Time-Spatial Information Cloud Platform for Smart City Development*, which

[6] *Notice of the General Office of MOHURD on Carrying Out the Development of National Pilot Smart Cities*, http://www.gov.cn/zwgk/2012-12/05/content_2282674.htm.

[7] *China Development Bank will provide an investment and financing amount of 80 billion yuan in the coming 3 years to support smart city development in China*, http://finance.people.com.cn/bank/n/2013/0114/c202331-20194680.html.

[8] *The 12th Five-Year Plan for Mapping and Geographic Information Technology Development*, http://www.sbsm.gov.cn/article/zcfg/zygfxwj/201202/20120200098291.shtml.

proposes that the pilot cities should, based on their built digital city geospatial framework, establish their time-spatial information databases and cloud platforms through newly adding or expanding the contents, functions and efficiency of their basic geographical information databases and geographical information public platforms.[9]

3.2 EU Policy Framework for Smart City Development

EU 2020 Goals

20 % reduction in greenhouse gas emissions from 1990 levels

3 % of the EU's GDP (public and private combined) to be invested in R&D/innovation

75 % of 20–64 year olds to be employed

10 % maximum school dropout rate

20 m fewer people in or at risk of poverty and social exclusion

There is great hope that smart cities will create a range of new jobs and services, through improvements in resource allocation and usage, through leveraging public investments in areas of innovative technologies and by creating focus points for entrepreneurs in all areas of technology supporting sustainable growth. The main focus of EU smart city policy measures is in facilitating smart cities projects to:

- Extract more value from existing infrastructure and capital, via research, technical development and innovation
- Create new products and services that generate economic growth and which meet social and environmental challenges[10]

In all the support measures from the EU level, the environmental dimension of smart solutions dominates. The programmes designated to the promotion of smart cities primarily aim at limiting energy use and cut carbon emissions. Smart cities are one element in the EU's efforts to reduce greenhouse gas emissions by 20 %, to increase the share of renewable energy to 20 % and to make a 20 % improvement in energy efficiency. These targets have been incorporated into the Europe 2020 strategy for smart, sustainable and inclusive growth and into the initiative 'Resource-Efficient Europe'.[11]

While these goals are the primary focus of the EU efforts, there are more partially related and partially independent targets, such as a more general support towards European competitiveness in various related fields, such as ICT, e-government, e-health or others. In order to be able to work with a specific focus,

[9] *The 12th Five-Year Plan for Mapping and Geographic Information Technology Development*, http://www.sbsm.gov.cn/article/zcfg/zygfxwj/201202/20120200098291.shtml.

[10] See Deakin, JESSICA for Smart and Sustainable Cities: Defining Smart and Sustainable Cities.

[11] http://ec.europa.eu/energy/strategies/2010/2020_en.htm.

the 'Advisory Group on ICT Infrastructure for energy-efficient buildings and neighbourhoods for carbon-neutral cities' recommended maintaining the 'energy-efficient neighbourhood' concept as the primary orientation mark. It also concluded (in its second meeting, Sept. 2011)[12]:

- Smart cities and communities' initiatives should focus on implementation of existing, advanced state-of-the-art products and services.
- Research is needed on communications-related aspects to facilitate integration and interoperability issues, on utility networks and cyber security issues, on overcoming financial barriers, on developing suitable frameworks for public-private risk-sharing enterprises and on societal aspects regarding behavioural change.
- Flexibility is required in terms of definition of city and community.
- Public-private partnerships are a vital success factor in 'smart' initiatives.
- Existing technology platforms, trade organisations and networks of towns and cities should be involved in the programme and in projects.

3.2.1 Commission Priorities

These considerations already indicate that there cannot be an isolated 'smart city solution'. Smart cities are an element in a regional development and innovation strategy package and require complementary policy measures as they are expected to make a meaningful economic, social and environmental impact. How various policy and industry fields need to work together in order to create a policy environment conducive to an environment within which the private sector can develop and implement innovative solutions for smart cities. These have been summarised by EU Commissioner Kroes, stressing five priorities of DG CNECT[13]:

- **Connectivity**: pan-European connectivity is to be promoted through increased work on high-speed broadband availability, as laid out in September 2013 as a proposal for a policy reform package under the headlines of 'Connected Continent' and 'Telecommunications Single Market'. As smart city systems and solutions, as well as entrepreneurs and developers, depend on high quality of communications infrastructure, this is considered a key prerequisite for any smart solutions to be implemented.[14]
- **Open data**: the recently agreed update on making public sector information available to the public by creating an 'open data by default' system, for the benefit of enterprises, citizens and the administration. Open data provisions allow

[12] Smart Cities Report, Advisory Group Workshop, September 16, 2011, http://ec.europa.eu/information_society/activities/sustainable_growth//docs/smart-cities/smart-cities-adv-group_report.pdf.

[13] http://europa.eu/rapid/press-release_SPEECH-13-680_en.htm?locale=en.

[14] See http://ec.europa.eu/digital-agenda/en/connected-continent-legislative-package for more details.

citizens and businesses to make creative and profitable use of the information resources of the public sector. Smart cities will benefit in facilitating the development of more and better solutions for key challenges such as transport and energy use but also for all walks of city life, if dynamic entrepreneurs can use government data to develop convenient and intelligent offerings to the citizens, to the administration and to local enterprises.[15]

- **Entrepreneurs and start-ups:** initiatives such as the 'Future Internet Lab'[16] promote a dynamic entrepreneurial culture around the smart cities, intended to create synergies and innovation hubs. This support for entrepreneurship and start-ups will consist of creating entrepreneurial environments where building blocks essential to creating new ideas will be supported and on which specific applications are expected to be more easily and fastly developed and brought to market.
- **5G**: the development of smart cities, and the technological requirements that come with it, will require a substantially improved next generation of networks. Smart city operation and management and the network usage demands of the businesses and citizens with regard to bandwidth, speed, reliability and security in an age of ubiquitous computing and Internet of Things call for network operators to move fast in entering the 5G stage. The EU Commission is supporting this in particular by helping to establish PPP structures for 5G development.[17]
- **Innovation**: very specifically oriented towards the support of smart city project development and implementation, a European Innovation Partnership on Smart Cities and Communities was launched by the Commission. The partnership is intended to bring stakeholders from all relevant sectors together, allowing them to share experiences and success stories and work together on overcoming existing challenges, with the aim to foster innovation at the intersection of the energy, transport and ICT sectors.

Details on the latter priority area, the European Innovation Partnership and related initiatives, are provided in the section on 'European Innovation Partnership for Smart Cities and Communities' below. While this is the only priority area targeted directly at the promotion of smart city solutions, it is important to note that without all five areas advancing in sync, smart city efforts are likely to remain as isolated technology projects and will fail to realise their impact on the quality of life and the environment. A detailed discussion of the other policy measures is beyond the scope of this report. However, considering them all as part of one coherent framework is strongly recommended

[15] On specific programmes aimed at open data for smart cities, see http://ec.europa.eu/digital-agenda/en/blog/open-and-smart-cities-common-future. On the EU's open data policy framework, see http://ec.europa.eu/digital-agenda/en/open-data-0.

[16] See the Commissioner's speech at the launch event: http://europa.eu/rapid/press-release_SPEECH-13-671_en.htm.

[17] See http://ec.europa.eu/digital-agenda/en/towards-5g for more details.

When looking at the member state level and at the level of individual cities and regions, it is not surprising to find an abundance of approaches to the development and operation of smart city initiatives. The EU is not just characterised by a heterogeneous structure but with respect to city governance by the principle of subsidiarity. This allows for most decisions affecting the city level to be made exclusively on that level, with limited influence of higher levels of the political hierarchy. This strong degree of independence of EU communities results in very different solutions being implemented with respect to any aspect of city modernisation. It also makes it somewhat more difficult to create national- or EU-level approaches to a common and coherent smart city development.

This lack of top-down decision-making authority is offset by the possibility to incentivise and encourage the cities to follow targets developed on EU or national levels by way of providing additional support. The financial situation of many EU communities is precarious, requiring not just new ways of finding possible partnerships with the private sector for service and infrastructure improvements but also creating the continued need for investigating the possibilities to benefit from national or European support programmes. As these programmes allow to jointly follow a coherent path and feature common themes such as regional cohesion, energy saving or waste reduction, they play an important role in streamlining the cities' set of policy goals with the goals agreed on at higher policy levels.

Apart from subscribing to the general goals of smart city development, there are also more practical challenges to the development of smart cities, such as developing strategic plans that guide the development and implementation process. The national and regional authorities need

> …to design the right framework and involve the local authorities and the municipalities to work in designing a coherent smart economy not only on infrastructures but also on building the services and the human resources for the future. This requires a strong local engagement and integrated approaches to planning. Many regional programmes in the past have lacked strategic focus and integrated actions.[18]

Each of the stages of a smart city project (comprehensive or a singular solution) will meet financing as well as managerial challenges, often requiring a whole new set of skills that often will have to be developed within a city administration for the first time. In the initial planning stages, it is vital to formulate a very clear understanding of where in the innovation/implementation chain the project is to be situated and from where in the respective stages know-how, support through national or EU level and funding can be expected. As will be shown below in the segment on 'financing support', there are many options for this, and bringing them together and creating synergies to support one city project or action plan can prove challenging.

[18] Smart Cities Stakeholder Platform Finance Working Group Guidance Document: Using EU Funding Mechanisms for Smart Cities.

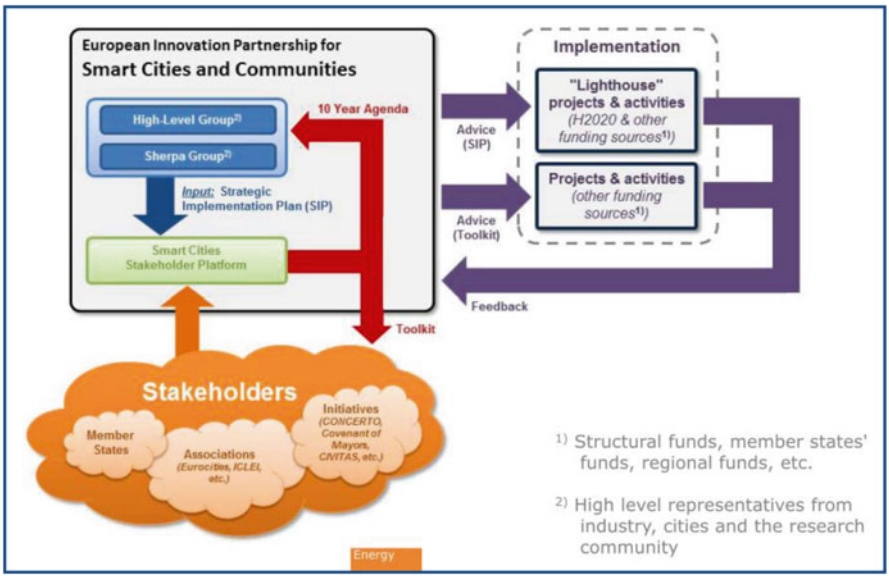
3.2.2 *European Innovation Partnership for Smart Cities and Communities*

The European Innovation Partnership for Smart Cities and Communities(EIP-SCC)[19] was officially launched in 2013. It is governed by the **High-Level Group**, with the **Smart Cities Stakeholder Platform** (see below) supporting the implementation.

The EIP-SCC seeks to establish strategic partnerships between industries and European cities to develop and roll out the urban systems and infrastructures of tomorrow. It aims to boost the development of smart technologies in cities by pooling research resources from **energy**, **transport** and **ICT** and concentrating them on a small number of demonstration projects which will be implemented in partnership with cities. The Innovation Partnership will be fully operational under 'Horizon 2020', the new research and innovation funding framework under the Multiannual Financing Framework 2014–2020.

The High-Level Group	**EU Smart Cities Stakeholder Platform**
The 'High-Level Group' consists of CEOs from ICT, energy and mobility/transport industries, city mayors, regulatory authorities and public financing institutions. It was established to support the implementation of the EIP-SCC. It is responsible (together with a 'Sherpa Group') for the Strategic Implementation Plan (SIP), which helps define how concepts to promoting smart cities are put into practice. It also looks at how the European Commission can support these measures during the Research Framework Programme – Horizon 2020	The EU Smart Cities Stakeholder Platform was initiated by the European Commission with the dual aim of
	Identifying and spreading relevant information on technology solutions and needs required by practitioners
	Providing information for policy support to the High-Level Group and the European Commission
	It is both a web-based and physical platform open to anyone who registers on it. The backbone is the contributions by stakeholders in a bottom-up way, owned by the stakeholders. The platform will bring city authorities, industry, NGOs and civil society together. It will accompany the implementation of the lighthouse projects and monitor the overall implementation of the Innovation Partnership. It will organise activities so that experience and knowledge from lighthouse projects will be shared

[19] http://ec.europa.eu/eip/smartcities/. This is a joint effort by: DG Energy: http://ec.europa.eu/energy/technology/initiatives/smart_cities_en.htm; DG Transport and mobility: http://ec.europa.eu/transport/urban/urban_mobility/urban_mobility_en.htm; DG CNECT: http://ec.europa.eu/information_society/activities/sustainable_growth/cities/index_en.htm.



Source: Houben, Smart Cities & Communities, ICT4E2B Forum, 28 February 2013.

At the first meeting of the High-Level Group, three priority areas were addressed: urban sustainable mobility, districts and built environment and integrated infrastructure and processes across these three sectors. Several priority issues and challenges, on which the SCC-EIP should make progress, were highlighted at the meeting[20]:

- **Citizen focus**: to motivate citizens to take an active role, the partnership's targets and activities need to be centred on them.
- **Open data:** new mechanisms and rules to be put in place to make pertinent data more accessible while also respecting privacy.
- **Baselines, performance indicators and metrics**: to create transparency and quantify progress, all actions need to be measurable against clear baselines.
- **Standards:** to improve predictability and to de-risk investments, existing standardisation activities need to be more closely coordinated and possibly expanded.
- **Procurement and financing**: to better reflect total costs of ownership and support for cities to join forces for greater purchasing power, also across borders, procurement processes need to be modernised.
- **Knowledge sharing**: to steepen the learning curve, city administrations and other stakeholders need to be able to build on past experiences in a systematic way. Annex 3: EU smart city knowledge exchange and cooperation platforms provides a summary of the main EU smart city knowledge exchange and cooperation platforms.

[20] http://ec.europa.eu/eip/smartcities/files/executive-reportDOUBLEHYPHEN1st-hlg-meeting_en.pdf.

- **Integrated planning and management**: to overcome silos in city administrations and industrial sectors, a systemic, holistic view is key, leading to integrated approaches for planning and management.
- **Business models**: to foster market uptake, to enable savings for cities and to offer competitive prices to consumers, new cross-sectorial business models are needed.

At its second meeting in October 2013, the High-Level Group adopted the partnership's *Strategic Implementation Plan (SIP)* as the basis for speeding up the deployment of smart city solutions in Europe. The SIP proposes a variety of actions to drive forwards improvements in these areas. These include a common set of smart city standards, 'open data by default', new ways of designing planning solutions, the creation of 'innovation zones', new business models and improving collaborative governance mechanisms dedicated to integrated city planning and management.

In February 2014, the EIP launched an Invitation for Commitment (ending in June 2014) to start building a marketplace for smart city actions in the EU and enable stakeholders to promote these on a European scale and partner with like-minded stakeholders. Interested parties are invited to join the EIP by committing to provide a measurable and concrete engagement in support of one or more focus areas, linking energy, transport and ICT in the urban context.[21]

3.2.3 Green Digital Charter[22]

The charter is a EUROCITIES initiative, started by the City of Manchester and Clicks and Links Ltd, as part of Green Shift Europe, and supported by the European Commission. The cities signing up to the charter (currently 30 cities from 15 EU member states) commit to reduce the carbon footprint of their ICT and roll out ICT solutions which lead to more energy efficiency in areas such as buildings, transport and energy.

The participating cities are committed to:

- Deploying five large-scale pilot projects before 2015
- Decreasing ICT's direct carbon footprint by 30 % by 2020
- Creating a partnership of cities on ICT and energy efficiency to work until 2011

While not specifically a smart city initiative, the Green Digital Charter's goals of reducing cities' carbon footprints makes it an important reference point for smart city initiatives and smart city projects as a viable option for the cities to comply with their commitments.

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[21] http://ec.europa.eu/eip/smartcities/about-partnership/how-do-i-get-involved/index_en.htm.

[22] For more details, see http://www.greendigitalcharter.eu/greendigitalcharter, http://eurocities.wordpress.com/eurocities%E2%80%99-green-digital-charter/ and http://ec.europa.eu/information_society/activities/sustainable_growth/green_digital_charter/index_en.htm.

3.2.4 Networking Intelligent Cities for Energy Efficiency

Networking Intelligent Cities for Energy Efficiency (NICE)[23] was established to promote and support the implementation of Green Digital Charter commitments. It is an accompanying measure to the charter developing a common implementation framework and reporting tools and information resources for classifying, measuring, reporting and supporting actions. It is led by EUROCITIES in a consortium with Clicks and Links Ltd, the City of Manchester and the Leibniz Institute of Ecological Urban and Regional Development. The initiative commenced in September 2011 and will run for 30 months until February 2014.

It is supporting signatory cities in three key areas:

1. **Tools for cities:** establishing monitoring and reporting tools for cities to be able to measure their ICT carbon footprint and link their work to other initiatives and developing frameworks for action to aid cities at all stages during their efforts to green ICT[24]
2. **City support and action:** offering practical support to cities through a series of targeted exchange and learning activities
3. **Outreach and engagement:** organising a series of networking and visibility events to increase the number of charter signatories and showcase cooperation opportunities with relevant stakeholders

With this range of support, NICE is not exclusively dedicated to smart city projects, but smart city initiatives can receive support in their ICT-related efforts to reduce their carbon footprints.

The project has a **special focus on the development of EU-China partnerships** as well as a close collaboration with the Covenant of Mayors. It also works closely with various initiatives of the international smart city community, such as the Smart Cities and Communities Platform. It is financed by the European Union under the EU research funding programme 'FP7',[25] specifically under the information and communication technologies theme.

3.2.5 Other Initiatives

Other initiatives within the EU that have some direct links and interrelationship with smart city projects are summarised in Fig. 3.1 below and Fig. 3.2 overleaf.

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[23] See http://www.greendigitalcharter.eu/niceproject and also http://ec.europa.eu/energy/technology/initiatives/smart_cities_en.htm.

[24] The toolkit is online at http://www.greendigitalcharter.eu/nice_toolkit/mainfeed.php but only accessible to registered charter signatories.

[25] FP7 is the 7th Framework Programme for Research and Technological Development. It will last for seven years from 2007 until 2013. The programme has a total budget of over €50 billion.

Initiative	Description
European Urban Knowledge Network	The European Urban Knowledge Network (EUKN) shares knowledge and experience on tackling urban issues. The key objective is to enhance the exchange of knowledge and expertise on urban development throughout Europe, bridging urban policy, research and practice
	http://www.eukn.org/
Joint Programme Initiative (JPI) Urban Europe	JPI Urban Europe is a research and innovation initiative of EU member and associated states to the EU Framework Programme and aspires to rethink and manage the increasing urban orientation and concentration in Europe in order to create and exploit synergy in an urbanised Europe, from an economic, social, environmental and transport-related perspective, leading to a strengthened global position of Europe
	http://www.jpi-urbaneurope.eu/
European Network of Living Labs (ENoLL)	ENoLL is the international federation of benchmarked living labs in Europe and worldwide. A living lab is a real-life test and experimentation environment where users and producers cocreate innovations. Living labs have been characterised by the European Commission as public-private-people partnerships (PPPP) for user-driven open innovation. A living lab employs four main activities
	Cocreation: codesign by users and producers
	Exploration: discovering emerging usages, behaviours and market opportunities
	Experimentation: implementing live scenarios within communities of users
	Evaluation: assessment of concepts, products and services according to socio-ergonomic, socio-cognitive and socio-economic criteria
	http://www.openlivinglabs.eu/
European Initiative on Smart Cities	'The European Initiative on Smart Cities' supports cities and regions in taking ambitious and pioneering measures to progress by 2020 towards a 40 % reduction of greenhouse gas emissions through sustainable use and production of energy. This will require systemic approaches and organisational innovation, encompassing energy efficiency, low-carbon technologies and the smart management of supply and demand. In particular, measures on buildings, local energy networks and transport would be the main components of the initiative
	The initiative builds on existing EU and national policies and programmes, such as CIVITAS, CONCERTO and Intelligent Energy Europe. It will draw upon the other SET-Plan Industrial Initiatives, in particular the Solar and Electricity Grid, as well as on the EU public-private partnership for buildings and green cars established under the European Economic Plan for Recovery.[a] The local authorities involved in the Covenant of Mayors (more than 500 cities) will be mobilised around this initiative to multiply its impact
	http://setis.ec.europa.eu/implementation/technology-roadmap/european-initiative-on-smart-cities

[a]http://ec.europa.eu/research/index.cfm?pg=newsalert&year=2009&na=ppp-310309.

Fig. 3.1 Other EU initiatives with links to smart city projects

National-level example: UK Future Cities Demonstrator Programme (http://goo.gl/vaqpnZ)
In 2012, the UK Technology Strategy Board started funding feasibility studies in UK cities to show the value of integrating city systems. The board identified three systems that lack viable solutions on the market. It initiated a competition to support their development and fill those gaps in the areas of
Platforms to identify community energy patterns down to the building level, with the ability to predict future demand
Data management platforms to connect the city's many disparate data sets, including innovative ways to analyse and display that data
Real-time route planners for commuters, delivery vans, tourists, etc.
Thirty urban areas across the UK competed for a £24 mio grant. They were granted 50,000 euro each to develop an innovative proposal to dramatically improve their performance. A condition for entering the contest was that entrants use non-proprietary data formats and APIs. They had to demonstrate the potential for wide-scale commercial deployment. The City of Glasgow won the competition and used the grant money to invest in 'super intelligent' CCTV cameras that can be used to raise alarm when unattended bags are detected and apps that can help visitors find the quickest routes
As a follow-up to the Future Cities Demonstrator Programme, the 'Future Cities Catapult' was established as a technology and innovation centre in London, with £50 million of government support over 5 years. It is intended to join business, city governments and academia in an effort to enable business to develop products and services for the cities of the future. It will test innovative business solutions through the demonstrator projects in Glasgow, London, Peterborough and Bristol

Fig. 3.2 National initiative with links to smart city projects

3.2.6 EU Support for Financing Smart City Projects

This section focuses on opportunities for cities to get access to financial resources from the EU level. It should, however, be noted at the outset that these funding possibilities frequently are only part of the overall burden of investment in smart infrastructure and services. In order to gain access to the funds, it is usually required to already have a coherent and reliable action and investment plan in place, with a credible mix of own resources and third-party contributions, for example, through public-private partnership agreements.

Studying the financing models used in practice by other cities can provide relevant input and inspiration about new and creative ways to bundle various kinds of resources into a feasible and realistic scenario for investment. The good-practice examples collected below in this report when describing the selected 'pilot cities' provide an overview of feasible investment and financing arrangements.

3.2.6.1 PPP and Financial Instruments

An increased emphasis will be on promoting on innovation and on a stronger industry involvement via the industrial deployment of key enabling technologies and through PPPs – institutional and contractual. PPPs are stressed as they are perceived

to ease solving problems together with industry, support the goal of European industrial leadership and facilitate prioritisation of research and innovation in line with Europe 2020 objectives and industry needs. PPPs can help leverage research and innovation elements and make industry more strongly commit industry to joint objectives.[26]

PPPs are specifically addressed in Article 19 of Horizon 2020 as a tool to implement R&I activities of strategic importance. The PPPs can be implemented either as 'Article 187 PPPs' (TFEU) or as 'contractual agreement PPPs'.[27]

PPPs shall be identified in an open and transparent way based on all of the following criteria:

- The added value of action at the union level
- The scale of impact on industrial competitiveness, sustainable growth and socio-economic issues
- The long-term commitment from all partners based on a shared vision and clearly defined objectives
- The scale of the resources involved and the ability to leverage additional investments in research and innovation
- A clear definition of roles for each of the partners and agreed key performance indicators over the period chosen

Several initiatives provide templates and guidelines to support the decision-making process. For example, the European Investment Bank's 'European PPP Expertise Centre' (EPEC), which supports PPP development across sectors, developed a standardised PPP model based on a project to upgrade street lighting in Germany[28] and a brief summary of the model is provided in Fig. 3.3 overleaf.

The EPEC has also published a 'Guide to Guidance' aimed at public procuring authorities considering the use of public-private partnership (PPP) arrangements and is offering the 'EPEC PPP Guide' as a web tool.[29]

There is an abundance of potentially applicable EU funding for smart city projects. As the definition of smart cities from the EU perspective is focused on the environmental and energy-related aspects, there are many funding instruments with complimentary goals. These sources of EU funding are not a one-stop solution to get smart city projects designed and financed. They typically only cover part of the overall investment burden (e.g. through subsidies, grants or other instruments that help alleviate investment risk). Combining these sources can pose a considerable planning and management challenge for the cities, which is also addressed in the EPEC PPP Guide.

The funding received through EU funds can be utilised through designated financial instruments. This means that, for example, an EU grant does not go directly to the beneficiary city but is received by a financial institution such as the European

[26] See Valles, Public-Private Partnerships in FP7 and in Horizon 2020.

[27] For more details on the distinction, see http://ec.europa.eu/research/industrial_technologies/.

[28] See von Thadden, Financing municipal PPPs, March 29, 2012.

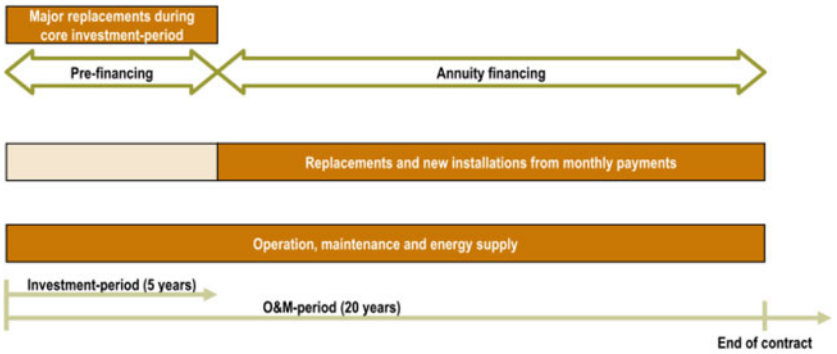
[29] http://www.eib.org/epec/g2g/.

Example: EPEC's standardised PPP model

Basic parameters:

- Contract period (of 20 years)
- Core investment-period (5 years), further investments with annual budget
- Operation and maintenance of facilities
- Energy supply
- Ownership of existing facilities remain with the municipality
- Transfer of ownership of new assets to municipality once they are operational
- Need for documentation of existing facilities, technologies, age and their status
- Output-based specification

Structuring the Street-Lightning PPP:



Lessons learned:

- PPP and partnering contracts offer fast replacement of old facilities to improve traffic safety and security
- Prior to tender an inventory of existing facilities must be prepared by the authority
- Case studies proof major energy-saving potentials, major cost-savings for municipalities and possible risk-transfer to private sector partners
- Further LED-developments will increase the saving-potentials
- In Germany about 15 EU tenders were closed for PPP street-lighting projects
- In the UK more than 20 EU tenders were closed for PPP street-lighting projects
- Over the following years many more tenders will be published (more than 300 concessions will be terminated in Germany)
- The models can be standardised and repeated, but financing needs to be adapted to the institutions available.

Fig. 3.3 Standardised PPP model developed by EPEC (Source: von Thadden, Financing municipal PPPs, 29.03.2012)

Investment Bank (EIB), which transforms it into loans, guarantees, equity and other risk-bearing mechanisms that better suit the needs of the respective city. While the use of financial instruments requires additional resources and experience, the institutions offering the instruments (such as the EIB) play an important role in helping to build up such expertise, increasing the efficiency and effectiveness of resource allocation by the cities. These financial instruments are of particular relevance for large-scale investments supported by EU grants.

3.2.6.2 EU Funds for Smart City Development

The EU Cohesion Policy, together with the EU's Competitiveness and Innovation Funds (Horizon 2020 and COSME), allows the development of powerful integrated energy, transport and ICT investments. Horizon 2020 and the EU Cohesion Policy are outlined below.

There is also the Competitiveness and Innovation Programme (CIP) to be considered, which supports innovation activities with a focus on SMEs. The Entrepreneurship and Innovation Programme (EIP), the ICT Policy Support Programme (ICT-PSP) and the Intelligent Energy Europe (IEE) facility are all further possible sources of support for ICT solutions in the smart city context. From 2014, the new programme for the Competitiveness of Enterprises and SMEs (COSME) 2014–2020 will take the place of the EIP.

The Smart Cities Stakeholder Platform's Finance Working Group has compiled a detailed guidance document which breaks down the various possible sources of EU funding for smart city projects. See Annex 4: EU funding sources for smart city projects for the overview and further references as well as Annex 3: EU smart city knowledge exchange and cooperation platforms for an overview over the smart city stakeholders platform.

Horizon 2020

Horizon 2020[30] is the new EU research funding programme (2014–2020), replacing the 'Framework Programme' (FP). It is expected to play a crucial part in leading Europe towards the 'Europe 2020' strategy goal of smart, sustainable and inclusive growth. Horizon 2020 is structured into distinct parts on scientific excellence, industrial leadership and societal challenges.

The programme has a short-term planning horizon (every 1–2 years). There is no predefined geographical distribution of funding, and projects have a transnational perspective. The programme will have a total budget of 77 billion euros. It complements other funding mechanisms, such as the cohesion programme. The Horizon 2020 will take full account of the EIP-SCC in making its funding decisions.

[30] For details see http://ec.europa.eu/research/horizon2020/index_en.cfm.

Lighthouse Projects

EU funding will be concentrated on a limited number of demonstration projects that demonstrate technology integration across sectors and where a city/community showcases that their approach can be implemented for reasonable costs and has advantages for citizens and the whole community. The selected projects will bring competent industrial consortia (composed of R&D intensive industries from the three sectors) together with several cities to demonstrate their advantages, so that other cities may follow to implement the same technologies. Selection and financing of these lighthouse projects take place within the Horizon 2020 framework.

Even before the start of Horizon 2020, €81 Million of EU funds were earmarked in 2012, covering two sectors: transport and energy. Demonstration projects financed under the scheme could be in either one of the two sectors – rather than the two combined. For 2013, ICT was added as a third sector and the available budget was raised to €365 million. Whereas in the first year, demonstration projects could be of either sector, from 2013, eligible projects must combine elements from all three sectors.

The call for proposals will be open to industry-led consortia operating in the three sectors: energy, ICT and transport. The consortia will need to include partners coming from three member states and/or associated countries teaming up with at least two cities.

MEMO/12/538 of July 2012 names examples of what kind of projects are eligible for cofinancing as 'lighthouse projects'. These are just an indication, however, as the actual project eligibility depends on the specific call for proposals. The examples mentioned were:

- **Smart buildings and neighbourhood projects**: for example, projects that expand the use of high-efficiency heating and cooling (using biomass; solar thermal, ambient thermal and geothermal heat storage; cogeneration and district heating); projects support the construction of nearly zero-energy buildings and positive energy buildings and neighbourhoods.
- **Smart supply and demand service project**: for example, projects which provide data and information to citizens and end users on energy consumption or production and multimodal transport and mobility services; smart metering and related services for energy, water and waste; monitoring and balancing the grid; or energy storage (including virtual energy storage).
- **Urban mobility projects:** for example, projects on public transport vehicles that are able to exchange surplus energy (braking and accelerating energy) with the energy system and projects to manage energy flows or using hydrogen as an energy carrier for storing energy and balancing demand at city level for energy and stationary power.

Smart and sustainable digital infrastructures: projects to reduce the carbon footprint of the Internet, in particular data centres and telecoms equipment, including broadband; intelligent heating, cooling and lighting solutions.

EU Cohesion Policy

EU Cohesion Policy[31] has the purpose to stimulate regional socio-economic development in Europe. Cohesion policy programmes are designed in shared management with national/regional authorities with a long-term perspective (3–7 years). The projects mainly involve actors from one member state or region.

In October 2011, the European Commission adopted a draft legislative package that will frame the 2014–2020 cohesion policy period. The plans for the 2014–2020 cohesion policy period have EUR 376 bn. allocated for spending in economic, social and regional cohesion policy. In March 2012, the European Commission presented the 'Common Strategic Framework' to help member states and regions in setting strategic direction for the next financial planning period with a focus on the 'Europe 2020' strategy for smart, sustainable and inclusive growth. The commission proposed additional incentives to further the use of financial instruments for territorial infrastructure, such as provided through the European Investment Bank's JESSICA programme (see below). These incentives include reduced cofinancing rates, the extension of the instruments to cover also the Cohesion Fund, the significant share of resources earmarked to energy efficiency and renewable energy and the introduction of a mandatory urban priority theme (minimum 5 % of the European Regional Development Fund, 'ERDF').

The cohesion policy will provide support of different investment priorities. Among the most relevant for smart city development are provided below:

- Shift towards low-carbon economy in all sectors: promoting low-carbon strategies for urban areas (Objective 4)
- Protecting the environment: improving the urban environment (Objective 6)
- Promoting sustainable transport: promoting sustainable urban mobility (Objective 7)
- Promoting social inclusion: support for physical and economic regeneration of deprived urban communities (Objective 9)

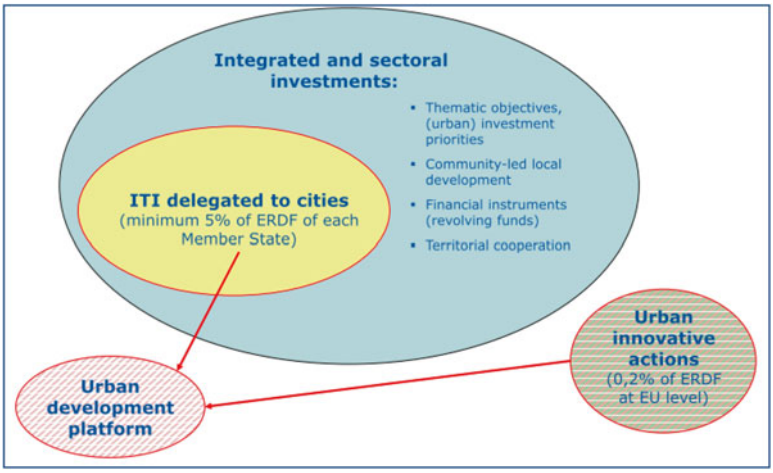
The urban development related aspects of the proposal for a cohesion policy under the Europe 2020 strategy seek to reinforce territorial cohesion by enhancing the integrated approach to urban development support, improving the involvement of cities and reintroducing an 'experimental strand' to city support.[32] The new structural funds strengthen the role of cities within the context of cohesion policy. The ERDF supports sustainable urban development through integrated strategies that tackle the economic, environmental, climate and social challenges of the functional urban areas. A minimum of 5 % of the ERDF resources allocated to each member

[31] For details see http://ec.europa.eu/regional_policy/what/future/index_en.cfm.

[32] See Haapakka, 'The urban dimension in the legislative proposals for cohesion policy', 2014–2020.

state will be invested in integrated actions for sustainable urban development potentially implemented through the Integrated Territorial Investment (ITI) tool.[33]

The main facilities within the Cohesion Policy Framework with respect to smart city development are Integrated Territorial Investments (ITI), Urban Innovative Actions and Urban Development Platform.



Integrated Territorial Investments (ITI): the ITI[34] aims to support integrated actions which can benefit urban areas as it offers the possibility to combine funding linked to different thematic objectives, including the combination of funding from the ERDF, ESF and Cohesion Fund (CF). The aim is to better support an integrated territorial or urban development strategy, with a specific target area at the appropriate territorial scale (e.g. at the level of neighbourhoods, cities, city regions, metropolitan areas, rural areas, functional areas).

Urban Innovative Actions: the 'Urban Innovative Actions'[35] instrument can play an important role to support smart city initiatives. Circa 370 million euros have been allocated until 2020 to promote innovative and experimental approaches and solutions in the field of sustainable urban development, such as smart city-related projects. Specific activities such as forward-looking and cutting-edge studies, pilot projects and demonstration projects of EU interest that are innovative and transferable can be supported through this facility. It is managed directly by the European Commission and awarded through Europe wide calls for proposals.

[33] The maximum of cofinancing rates will be: 75–85 % in less-developed and outermost regions, 60 % in transition regions and 50 % in more developed regions. See Smart Cities Stakeholder Platform Finance Working Group Guidance Document: Using EU Funding Mechanisms for Smart Cities.

[34] Article 7 ERDF regulation (recital 7); Article 99 CPR (recital 21, 65).

[35] Article 84 par. 7 CPR; Article 9 ERDF regulation (recital 9 and 12).

Urban Development Platform: the Urban Development Platform (UDP)[36] is to promote the practical implementation of the urban dimension. It fosters the exchange of experience and capacity building through conferences, working groups for specific issues, best-practice documentation, etc. Target groups are cities managing and implementing ITI and cities implementing Urban Innovative Actions.

The cohesion policy and the Horizon Programme share the same programming period of 7 years (2014–2020) and can be synchronised for more synergies and wider funding access. They serve the Europe 2020 strategy for smart, sustainable and inclusive growth. The key instrument to maximising the synergies with Horizon 2020 and EU Cohesion Policy is the development of **research and innovation strategies for smart specialisation**. All cities and regions need to prepare a 'smart specialisation strategy' as a condition for approval of the research and innovation elements of the national Partnership Contracts and Operational Programmes of Cohesion Policy 2014–2020.

3.2.6.3 The Role of the European Investment Bank

As stated above, the EU Commission proposed additional incentives to further the use of financial instruments for territorial infrastructure. The European Investment Bank (EIB)[37] plays an important role for cities seeking to make use of such instruments, as it developed instruments specifically targeted to complement EU budget funds and private investments a city has available, providing additional range and flexibility with respect to the use of the existing financial resources.[38]

In general, the EIB selects and prioritises projects in various sectors, maximising its impact on the real economy in line with the EU priorities for growth, employment, cohesion and economic sustainability. The EIB supports the EU Cohesion Policy objectives, contributing capacity to work in partnership with public authorities to speed up and increase the quality of implementation and increase absorption capacity and leverage of EU funds. It supports EU strategies, including 'Europe 2020', through direct lending as well as through technical and financial assistance by undertaking joint initiatives with the European Commission (and other IFIs).

The EIB is implementing new products combining EU funds and EIB lending to achieve greater leverage, i.e. supporting more investments with a given amount of EU budget and EIB capital resources. These innovative facilities rely on risk sharing and the blending of guarantees, grants and financing instruments. In the context of smart city development, the most relevant instruments are[39]:

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[36] Article 14 (b) CPR; Article 8 ERDF regulation (recital 8 and 13).

[37] http://www.eib.org/infocentre/events/all/jessica-delivering-smart-city-projects.htm and Barrett, Contribution of EU Financial Instruments to Smart and Sustainable Cities.

[38] See Smart Cities Stakeholder Platform Finance Working Group Guidance Document: Using EU Funding Mechanisms for Smart Cities.

[39] Relatively risky RDI projects can also benefit from the Risk-Sharing Finance Facility (RSFF), a joint financial instrument that leverages its capital to provide loans, guarantees and equity-type investments for projects with a higher-than-normal risk profile. Urban projects with an innovative character are in principle eligible for RSFF financing. See http://www.eib.org/products/rsff/index.htm.

- **ELENA** (European Local Energy Assistance)[40]: ELENA is an instrument specifically supporting the early stages of developing a smart city plan. It assists local authorities in development of energy efficiency and renewable energy plans. ELENA seeks to increase the capacity of local authorities to develop sound investment programmes by covering part of the cost for technical support that is necessary to prepare, implement and finance an investment programme (e.g. feasibility and market studies, structuring of programmes, business plans, energy audits, preparation for tendering procedures).
- **JESSICA** (Joint European Support for Sustainable Investment in City Areas)[41]: it was established in order to create 'financial engineering instruments' to support the member states in deploying EU structural funds. It is a joint initiative of EC, EIB and CEB. Currently, EUR 1.77 bn. has been committed to 18 EIB JESSICA Holding Funds, and 29 Urban Development Funds ('UDFs') have been established. These UDFs are 'policy-driven, geographically focused and planning-led investment vehicles supporting the sustainable transformation of urban areas'.[42] They can provide additional sources of funding and thus lower senior debt requirements and lead to an improved capital structure and senior debt credit quality. Funding cost for smart city projects can be reduced through the use of the JESSICA instruments. By helping to reduce the default probability and potentially reduce the overall funding costs, JESSICA can improve the financing capacity of municipal PPPs.[43]

JESSICA support is aimed at projects that could be commercially viable in principle but require support to get there as illustrated in Fig. 3.4.

3.2.6.4 Combining Resources

Figure 3.5 overleaf, shows how an urban plan can be linked to support from a variety of funding sources. The ERDF urban funds can support JESSICA style instruments for infrastructure development, which can be linked to energy and transport grids supported by the ERFD and Cohesion Fund, as well as human capital development by the ESF. The support instrument COSME can also provide support for innovative SMEs. Horizon 2020 can be used for demonstration projects and new technology deployment. Some of these funds are managed by the regional authorities; some (such as COSME or Horizon 2020) are not.

In addition there are specific instruments that can be integrated to the programming process, such as the use of the European Energy Efficiency Funds, ELENA, the planned deep green platform by the EIB for energy efficiency, etc.

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[40] See www.eib.org/elena and http://ec.europa.eu/energy/intelligent/index_en.html.

[41] http://ec.europa.eu/regional_policy/thefunds/instruments/jessica_en.cfm.

[42] See Bhana, JESSICA implementation mechanism and state-of-play.

[43] For more information on JESSICA and how it can be used to support smart city and other urban development projects, see the overview at: http://ec.europa.eu/regional_policy/thefunds/instruments/jessica_en.cfm#1.

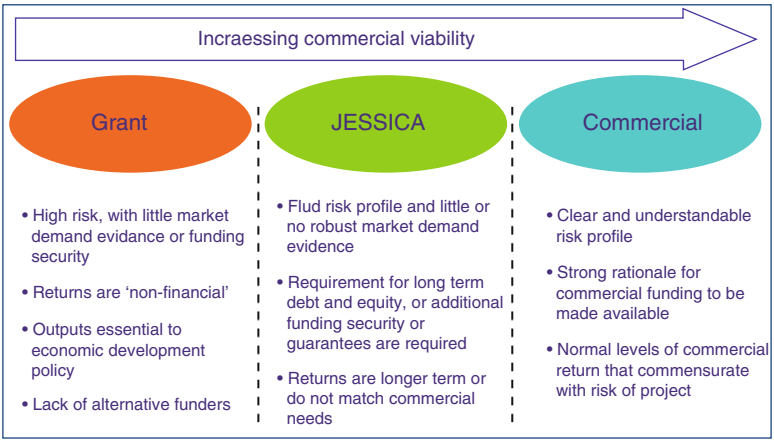

Fig. 3.4 Sources of funding

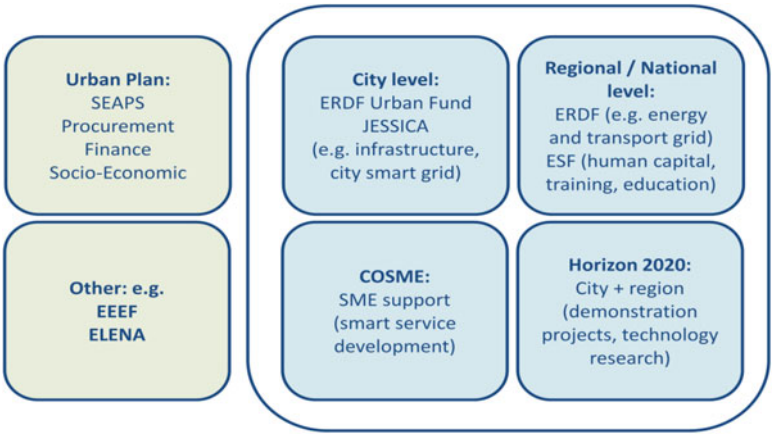

Fig. 3.5 Using EU funding mechanisms for smart cities (Source: based on Smart Cities Stakeholder Platform Finance Working Group Guidance Document: using EU funding mechanisms for smart cities)

Chapter 4
Assessment Framework for Pilot Cities

4.1 Pilot Cities

Thirty cities from the EU and China were selected to participate in the study. The criteria for selecting the pilot cities are described below.

4.1.1 China Pilot Cities

China has selected 15 cities to participate in the study based on the selection criteria provided below:

- Adhering to the concept of green, low-carbon and sustainable development and laying long-term emphasis on the use of ICT to promote urban construction and management levels.
- Having preliminarily completed the 'smart city' strategic planning or related action plans and having established clear smart city development goals.
- Having sound construction of information-based infrastructure facilities and a sound broadband and wireless communication network environment and having strong capacity in application of advanced information technologies and information system implementation and capacity for further evolution.
- Having a sound environment in the aspects of informatisation development policies, funds and talents and a good development and cooperation foundation and having the vision, talent, resources and capabilities for implementation of international cooperation.
- In organisation and management, a smart city construction leadership group should be established. The top municipal leaders should serve as the leaders of the group and the directors of departments should serve as its members. Specific working units should be established to be responsible for the construction of smart city.

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_4

- In basic information, an information resource co-building and sharing mechanism and an information resource platform should be established to realise sharing of population, geography, legal person and macroeconomic information resources. They should be applied for the sharing of specialised information resources such as transport, weather and medicine among main departments.
- In urban transport management, the city should be able to make use of the Internet of Things, mobile Internet, cloud computing, video monitoring, geographical information technology and other technologies to establish a unified management system in the whole city and improve the urban transport operation efficiency to make it convenient for public transport and reduce carbon emissions.
- In urban energy management, the city should make full use of energy saving and environmental protection materials for architectural construction and design and make use of the Internet of Things, mobile Internet, cloud computing and other information technologies to carry out monitoring and management of energy consumption, promote energy saving and emission reduction and enhance use efficiency.
- In education, the city should make full use of the broadband network, wireless network, cloud computing and other technologies to build education information resource management and utilisation systems, such as unified educational resources sharing platform and teacher training platform, to realise high-quality resource co-building and sharing, promote education justice, establish an information service system for people's lifelong learning and promote the balanced development of urban and rural education.
- In medical and health services, the city should make full use of the Internet of Things, the Internet, cloud computing and big data technologies to gradually establish the electronic health records for residents and establish a unified medical service platform for the whole city to promote resource sharing of the hospital system and improve medical services and healthcare levels.

The 15 selected pilot smart cities are:

1 Beijing Haidian District
2 Tianjin Binhai New Area
3 Shanghai Pudong New Area
4 Yangzhou of Jiangsu Province
5 Nantong of Jiangsu Province
6 Huai'an of Jiangsu Province
7 Ningbo of Zhejiang Province
8 Jiaxing of Zhejiang Province
9 Zhangzhou of Fujian Province
10 Yantai of Shandong Province
11 Guangzhou Nansha District of Guangdong Province
12 Authority of Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone of Shenzhen, Guangdong Province
13 Zhuhai Hengqin New Area of Guangdong Province
14 Chengdu of Sichuan Province
15 Korla of Xinjiang Uygur Autonomous Region

4.1.2 EU Pilot Cities

The process for selecting the EU smart city pilot cities to participate in this study was based on selecting cities which possess a range of best practices in smart city development, which are capable of being replicated.

As a basic requirement the EU cities must also adhere to the concept of 'green, low-carbon and sustainable development' and have a long-term emphasis on the use of information and communication technologies to promote urban construction and management levels. Over and above this basic level of competence, it is recognised from such EU-funded initiatives as the Providing Portability of Best Practice Project (P*P*P), which set out guidelines for the transfer of best practice, a willingness to share and actively collaborate, based on existing visions and strategy, was vital. Pivotal to the findings of P*P*P was that a variety of tools were available, but a very important one involved the formulation of 'communities of interest'.

These 'communities of interest' would enable a mechanism to evolve for sharing best practice in a collaborative way, in which both parties would gain, with no notion of there being a donor or receiver of best practice.

Therefore, the key criteria for selection in this study was a city should have the ability and wish to collaborate, evidenced by participation in a range of initiatives and projects such as:

- Leading participation in EU networks such as EUROCITIES (www.eurocities.eu), EU e-Forum (www.eu-forum.org), Global Cities Dialogue, NICE project's Green City Charter (www.greendigitalcharter.eu/niceproject), etc.[1]
- Active profile in key EU events covering smart cities
- Linkage with existing EU-China initiatives such as CEPAII for governance of a smart city, the Urbanisation Project and Open China
- European leadership in smart city technologies and participation in projects
- Willingness to take a leading role in this field
- Mature smart city programmes
- Ability to give added value in promoting the project and having a multiplier effect

The 15 selected pilot cities are:

1 Amsterdam, Netherlands
2 Barcelona, Spain
3 Bristol, UK
4 Copenhagen, Denmark
5 Florence, Italy

[1] It should be stressed that there is a large number of towns, cities or regions that are currently working on small- or large-scale efforts to use ICT for infrastructure modernisation. While there is no 'certification' to qualify a city to be 'smart', the city or regional examples found on the websites of these networking initiatives provide an overview over the scope and nature of the respective efforts. For more examples of dedicated smart city initiatives, see Annex 3: EU smart city knowledge exchange and cooperation platforms.

6 Frankfurt, Germany
7 Issy-les-Moulineaux, France
8 Lyon, France
9 Malmö, Sweden
10 Manchester, UK
11 Riga, Latvia
12 Tallinn, Estonia
13 Venice, Italy
14 Vilnius, Lithuania
15 Zagreb, Croatia

4.2 Assessment Framework

An assessment framework, incorporating the key characteristics that are common to smart city projects, was developed to capture information from the pilot cities. The assessment framework provides a shared language and mutual understanding of smart city concepts for the pilot cities, thus ensuring the data is analysed in a consistent manner. The objective of the assessment framework is not to rank the pilot cities projects. Instead, the goal is to compare the various characteristics of each pilot city in order to:

- Identify 'good practice' within the various components of a smart city project
- Assess the cities against a common set of criteria
- Evaluate the benefits from smart city projects
- Understand emerging challenges in smart city projects

The assessment framework incorporates the findings from several papers that have proposed smart city frameworks.[2] The assessment framework comprises of nine characteristics: (1) smart city strategy, (2) stakeholders, (3) governance, (4) funding, (5) value assessment, (6) business models, (7) ICT infrastructure, (8) smart city services and (9) legal and regulatory policies.

Fig. 4.1 provides the smart city assessment template which was completed by the pilot city projects.

[2] Literature review:

i 'Understanding Smart Cities: An Integrative Framework', Hafedh Chourabi, Taewoo Nam, et al., IEEE Computer Society, 2012.
ii 'Smart City Framework, A Systematic Process for Enabling Smart + Connected Communities', Gordon Falconer, Shane Mitchell at Cisco, September 2012.
iii 'Smart cities – Ranking of European medium-sized cities', Centre of Regional Science at the Vienna University of Technology, Research Institute for Housing, Urban and Mobility Studies at the Delft University of Technology and the Department of Geography at University of Ljubljana, 2007, http://www.smart-cities.eu/model.html.
iv Intelligent community indicators; www.intelligentcommunity.org.

Characteristic		Description
1	Smart city strategy	What is the smart city's vision and objectives? Please include, where appropriate, the city's vision and objectives for Environment Energy Transport Waste management Urban-rural cohesion Quality of life Provide details of the key performance indicators (KPIs) that are used to measure the city's performance in meeting the smart city objectives Are KPIs benchmarked against international standards such as the 'Global urban competitiveness index', www.gucp.org/en/; Global City Indicators Facility (GCIF), www.cityindicators.org/; Green City Index, www.siemens.com/entry/cc/en/greencityindex.htm or other standards? If so, please provide details Does the city have an ICT strategic plan in place to ensure major technology trends are included in their city planning? If so, please provide evidence
2	Stakeholders	Who are the key stakeholders involved in the decision-making of the smart city development? For example, stakeholders may include government (federal, municipal, local, etc.), regulators, land and property developers, ICT service providers, systems integrators, utility providers, transport operators, citizens, etc. Describe how citizens are engaged in the smart city development. For example, what role do citizens play in designing, developing and improving smart city services? Does the city use crowdsourcing or other technologies such as gamification as a mechanism to engage with citizens? If so please provide an example How does the city promote and publicise smart city developments to stakeholders? What kind of training is provided to help citizens adopt new services?

Fig. 4.1 Smart city assessment framework

3	Governance	Describe the organisational/management and governance structure of the smart city development, for example, What are the roles of the leader and champion of the project? What are the roles, responsibilities and interrelationships of the key stakeholders? What level of cross departmental governance structure is in place, i.e. to ensure collaboration across the city planning development process? What is the process to allow stakeholders to participate in decision-making? How does the governance process ensure there is transparency and accountability of the various stakeholders? Does the city use ICT to improve their governance, i.e. enable new and better decision-making processes and/or incentive systems? If so, please provide examples
4	Funding	What is the source of funding to finance the smart city development? For example, municipal government, land sales, EU grant, social impact bonds, private investors, etc.? How much of the funding was from private and public sources? What business structures have been established, e.g. PPP, JVs? How much funding was required to finance the smart city development? What process was used to raise funding and how long did it take to secure funding? Describe any funding issues that may have arisen, e.g. budget overruns, insufficient funding to complete the project goals
5	Value assessment	What are the economic, environmental, social and cultural outcomes/impact from the smart city development? For example, What, if any, was the amount of business and/or jobs created? What, if any, was the increase in GDP? What, if any, were the reduction in C02 emissions, traffic congestion, etc., and the value in financial terms? How was the health service improved, e.g. reduction in appointment waiting times and the value in financial terms? Does the city use any tools or a framework to measure the 'social return on investment'? If so, please specify
6	Business models	Provide a brief overview of the business models that are being used to monetise smart city investments. For example, Risk-sharing initiatives, e.g. technology vendor/telco providing the IT infrastructure in return for a share of future revenue streams Using revenue generated from road congestion charges to finance public transport systems

Fig. 4.1 (continued)

7	ICT infrastructure	Describe the current investment in ICT infrastructure, i.e. hardware and software assets, including Broadband (fixed and wireless) network penetration Data centre infrastructure Geographical information system technology Public, private, hybrid cloud platforms Passive/intelligent sensors Video monitoring, etc. Who are the key suppliers, vendors, system integrators and partners involved in providing the smart city infrastructure? Is the ICT infrastructure managed or shared across smart city projects? If yes, describe how this is achieved What measures is the city taking to 'future proof' its investment in ICT infrastructure? Does the city have a plan to roll out ICT infrastructure to meet future demand? If so, who is responsible for developing the plan? Is their sufficient funding to finance the roll-out?
8	Smart city services Education Economic stimulus Environment Energy and utilities Food safety Health Intelligent buildings Logistics Community development Open data Prevention, e.g. crime, disasters Public services/administration Transportation Waste management Water Other	Describe each smart city service (as per the classification in the left-hand column) that is provided by the smart city development. The description should include the following information: The date the service was launched A high-level system/technical overview of the service including details of whether the service is Scalable, i.e. could the application be expanded within the city and/or to other cities? Delivered over the cloud? A single service or part of a broader integrated offering? Designed with an open Application Programming Interface (API)? Making use of the Internet of Things Who the services is targeting, e.g. businesses, health service providers, older people (60+), unemployed people, etc. The benefits (financial and nonfinancial) resulting from the services What plans the city has to develop/expand/enhance the service, e.g. Utilising advanced data analytics/big data technology to make better use of city data and information Making better use/sharing of ICT infrastructure What measures/actions have been taken to ensure that minority groups and people with no or poor digital literacy can use the service? In your opinion, do any of the smart city services represent 'best practice'? If so, please explain why

Fig. 4.1 (continued)

9	Legal and regulatory policies	Describe the key legal and regulatory policies that have had a material impact (positive/negative) on the development of the smart city development, for example, Telecommunications Building regulations Security and privacy Intellectual property etc. Describe what polices have been put in place to ensure the physical smart city infrastructure is secure, for example, Disaster recovery management of ICT and other city infrastructure such as electricity, gas, water, etc. Business continuity planning Describe any other areas where the city has developed new policies to improve the outcome of smart city developments

Fig. 4.1 (continued)

Chapter 5
Synopsis of EU-China Pilot Smart Cities

A synopsis of the completed 'Smart City Assessment Framework' is provided below, followed by an assessment of the cities' level of 'smart city maturity' in Chap. 6.

It should be noted that both the pilot smart city short profiles and the assessment is based on the information contained in the completed Smart City Assessment Framework (see Fig. 4.1), *which was provided by a senior representative of the pilot smart city*. The pilot smart city short profiles, provided below, in most cases, represent a summary of the information provided by the cities.

5.1 China Pilot Smart Cities

5.1.1 Beijing Haidian District

The general situation of the economic and social development of the city
Beijing, as the capital and political and cultural centre of China, is a world famous ancient city and modern cosmopolis. Standing in the northwest of Beijing, Haidian District is important and famous for its science and technology, culture, education and tourism. It, consisting of 22 subdistricts and 11 townships, has a total area of 426 km^2 and a resident population of 1.5 million
In 2012, Haidian's GDP reached 349.79 billion yuan and per capita GDP reached 100,390 yuan. Special geographical and resource advantages contribute to its multilevel comprehensive environment for science and technology, education and culture
Does the city have a strategy, plan, or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

(continued)

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_5

A series of documents such as the Smart Haidian Top-Level Design, Smart Haidian Development Program and Smart Haidian Construction Program introduced by Haidian specify the main contents including development objectives, key tasks and implementation steps. Smart Haidian aims to build smart administration, parks, urban areas and homes and IT industry highland by combining local features to fully embody its dominant position in the national information industry	
Smart administration: it embodies government service innovation, deep integration and sharing of resources, efficient operational synergies and intelligent decision support	
Smart parks: it builds eco-friendly smart parks with complete information infrastructure, efficient interaction between business and government, active industrial services and smart park management for efficient business operations	
Smart urban areas: it builds smart urban areas to fully detect urban components and events and manage the district in a lean way	
Smart homes: it creates smart homes that deliver services such as social security at the community level and benefit people with public services by building an integrated community information service system to raise the quality of life	
IT industry highland: it builds internationally influential information industry clusters by strengthening and demonstrating applications of products and technologies in the parks and actively nurturing a new generation of information technology industry	
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Wireless and fibre-optic and other basic networks and data centres in Smart Haidian are shared by different projects of Smart Haidian. ICT infrastructure is shared by different projects via a cloud platform built with cloud computing technology, Haidian administration network, data centre, public network and other communication technologies. Haidian spatial data sharing platform is built for the Haidian GIS technology and other business applications	
Haidian has achieved deep resource integration and sharing of government departments, efficient operational synergies and smart decision support through smart administration. It explores and shares resources between sectors and levels; accurately masters economic operation, public opinion and other economic and social developments and trends; and strengthens integration of portals and service hotlines according to the needs of residents to build a one-section and one-stop service system for enterprises and residents	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Smart government affairs:** a new project which is an information-based system construction of the Comprehensive Administrative Service Centre. When it is completed, a 'three-level interlinking' service mode will be established, in which districts, neighbourhoods and communities are fully covered with one service hall, one website and a 24-h self-service station of government affairs. This will improve service quality and make government affairs more transparent and realise data interconnection, business coordination and resource sharing in government affairs
Service 2	**Smart city management:** the grid-structured social management service system which realises grid-structured regional management, in order to reflect social situations and public opinions in a timely manner and considerably improve precise city management and fast handling ability

(continued)

Service 3	**Smart park:** energetically promotes the construction of a comprehensive service platform for enterprises in the central zone of Zhongguancun. The platforms include financial services, information service, innovative marketing service and enterprise operation monitoring for MSMEs (medium, small and microenterprises) in Haidian District. The integration of various systems and platforms provides enterprises in Zhongguancun Park with professional services in credit financing, innovative marketing, corporate management, intellectual property rights, etc., and promotes the development of SMEs (small- and medium-sized enterprises)
Service 4	**Smart education:** improves the education network in Haidian district. A cloud resource centre has been built and a two-level (district and schools) digital education management system has been established to profoundly combine information technology with teaching and keep education informatisation of Haidian district in a leading position in China
Service 5	**Smart sanitation:** based on a uniform regional sanitation information and data centre. The platform shares and exchanges sanitation information and resources in the region. This realises the sharing and exchange of health files in community sanitation system, electronic medical history in the information system of all district hospitals and sanitation statistical information

Please describe the measures on organisation, policy, funding and business model of the smart city development

As for building and organisation, Smart Haidian is built under the full responsibility of Haidian District Government, with Haidian's smart city industry alliance (intermediary organisation), project management units, consulting and design units and deputies to the NPC involved in the decision-making process. To ensure the construction and implementation, a work leading group led by a district governor and deputy district governors with leaders of district bureaus and industry experts involved has been set up, responsible for considered decisions on its major projects. Other stakeholders participate in the decision-making in accordance with the processes of government management measures

As for policy support, it has successively released the Smart Haidian Top-Level Design, Smart Haidian Project Management Measures, Smart Haidian Development Program and Smart Haidian Construction Program, which guarantee its construction from overall design to specific implementation

As for capital investment, Haidian invested about 300 million yuan annually in 2011 and 2012 and 500 million yuan in 2013, which mainly comes from district government financial allocation. Projects are funded through bidding by the financial allocation implemented according to the general financial allocation cycle, so the funds are safe and controllable. In addition, Haidian mobilises social capital[1] by using service leasing; Build, Operate and Transfer (BOT) and other ways

As for progress model, Haidian adopts a variety of models including the Build and Transfer (BT) and Build and Operate (BO) applied in the basic network and data centre construction

[1] Social capital is nongovernment funding.

5.1.2 Tianjin Binhai New Area

The general situation of the economic and social development of the city
Binhai New Area of Tianjin is located in the meeting point of the Beijing-Tianjin Urban Area and Circum-Bohai Urban Area, with a total area of 2,270 km^2 and a resident population of 2.53 million. It functions as an opening-up gateway to northern China, high-level manufacturing and R&D transformation base, northern international shipping centre, international logistics centre and liveable ecological new urban area
Binhai New Area has formed eight competitive industries, namely, aerospace, electronic information, petrochemical, automobile and equipment manufacturing, biopharmaceutical, new energy and materials, foodstuff and light and textile industry, and established development area, bonded port area, high-tech zone, Sino-Singapore Tianjin Eco-City Investment and Development Co., Ltd (SSTEC) and other forms of functional areas
In 2012, the Binhai New Area's GDP reached 720.517 billion yuan, with 240 billion yuan from electronic information industry. It, hailed as China's most potential and dynamic area, has become one of the areas that hold the highest degree of openness and return on investment in China
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Binhai New Area has introduced the *Medium-term Implementation Program for Smart Binhai Construction* and is preparing the Smart Binhai Top-Level Design and key project plan. Its overall objective for the smart city is to build a beautiful Smart Binhai by giving full play to information technology in economic and social development
It focuses on promoting the '4211' architecture system construction, namely, carrying out four projects – smart government, city management, economy and livelihood; building information infrastructure highland and emerging information industry highland; establishing a set of security systems; and building a card of Smart Binhai. By the end of 2015, it will initially build a smart area characterised by instrumentation, interconnection and intelligence
Binhai New Area, with particular attention to ecological development concept in the construction of smart city, proposes such objectives as:
Keeping annual average concentration of PM2.5 at 50 micrograms/cubic metres or less
Increasing urban sewage treatment rate to 98 %
Reclaimed water utilisation rate to 70 %
Urban living garbage treatment rate to 100 %, etc., by 2020
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Binhai New Area is the first in the city to initiate and complete the construction of 'One Network, One Cloud Centre And One information Resource Platform'. It plans to build a network, i.e. an e-government network covering the new area, to distribute electronic documents by using the unified office system in the whole district government rather than independent business networks to improve document flow speed
It plans to build a centre, i.e. Binhai New Area e-government cloud centre, and computing services platform, to eliminate the need for departments to build separate computer rooms and data centres, and nine systems such as safety supervision and emergency management system, disclosure and integrity system for key project construction sectors and public geographical information system have been deployed for operations in the cloud centre. It plans to build a platform, i.e. a GIS-based platform for sharing demographic, legal person, geographic, economic and other basic information databases, to serve information application system construction in different departments and 15 departments on geographical information applications and business systems development

(continued)

The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**An e-government cloud centre and cloud computing services platform,** based on the National Supercomputer Center in Tianjin and other cloud computing resources and local IDC resources in the area, is built to achieve efficient intensive development of e-government projects
Service 2	**GIS platform** is built to support multiservice applications with a set of base maps by supporting base map data, relevant base data of units and geographical information-related application system construction of units
Service 3	**Work safety emergency management system** provides daily supervision, early warning and emergency rescue and other services for all levels of safety regulators to improve work safety supervision and monitoring performance; carries out dynamic monitoring on important sources of danger, key enterprises (parts), etc., to achieve security accident source control; and provides emergency rescue commanding, scheduling and other functions to improve the response and decision-making ability of government with regard to emergencies
Service 4	**Police emergency command and control system** is built to connect to the command centre, headquarters and video conference rooms of the city and communicate with, command and deploy subbureaus under its jurisdiction
Service 5	**Utility operation and maintenance centre** achieves data, business, knowledge and information sharing by integrating the monitoring, operation, maintenance and emergency scheduling of water supply, electricity supply, gas supply, heat supply, public transport, environmental quality, communications and other public utilities
Please describe the measures on organisation, policy, funding and business model of the smart city development	
As for building and organisation, the organisational structure for Binhai New Area smart city construction consists of a leading group, a leading group office and specific departments. The leading group serves as a decision-making and coordinating body for smart city construction; the leading group office is responsible for specific implementation; the information technology department is responsible for the overall construction of smart city information infrastructure; each department undertakes specific tasks; and the advisory committee of experts provides guidance	
As for policy support, it has formulated the 12th Five-Year Plan for Information Technology Development in Binhai New Area and the Medium-Term Implementation Program for Smart Binhai for overall planning of Smart Binhai design and started preparing the Binhai New Area Broadband Strategic Plan to guarantee infrastructure construction	
As for capital investment, direct public investment of Binhai New Area will total two billion yuan during the 12th Five-Year Plan period, with the sources from government and business investment. Government investment consists of direct investment of Binhai New Area Government and national and Tianjin financial support. The special funds from the district government for informatisation and project-specific funds are usually implemented in 6 months or so; business investment includes BT model by the government to attract business investment and self-directed business investment	
As for progress model, Binhai New Area adopts a variety of construction and operating models. At present, the government purchases social services and rents facilities and cloud services to build infrastructure layout	

5.1.3 *Shanghai Pudong New Area*

The general situation of the economic and social development of the city
Shanghai is located at the estuary of the Yangtze River, facing Japanese Kyushu Island across the East China Sea in the east, neighbouring the Hangzhou Bay in the south and Jiangsu and Zhejiang Provinces in the west, together with which Shanghai leads the Yangtze River Delta Economic Zone, China's largest economic zone. Shanghai is China's most famous industrial and commercial city and cosmopolis, the largest comprehensive industrial city and a centre for economy, transportation, technology, industry, finance, trade, exhibition and shipping
Pudong New Area is in eastern Shanghai and at the eastern edge of the Yangtze River Delta, with a total area of 1210.41 km^2 and a resident population of 5.154 million
In 2012, Pudong New Area's GDP reached 592.991 billion yuan, with the sizes of electronic information industry and software and information service industry being 268.9 billion yuan and 175.4 billion yuan, respectively
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
The *iPudong 2015* developed by Pudong New Area puts forwards the objective of smart city to improve the public well-being and city operating efficiency with 'Smart Leads Model Changes' as the main line, by promoting digital, networked, intelligent, interactive, integrated and open IT applications in social development, national economy, urban management and public services according to the information age characteristics of wireless, high speed and integration
At the end of the 12th Five-Year Plan period or later, it seeks to basically build a Smart Pudong frame system to achieve a new stage of development featured by high coverage of infrastructure, highly ecological industrial development, highly developed application system and high degree of living harmony and build Pudong into a pilot and demonstration area for domestic smart city construction
The key tasks for Pudong's smart city construction can be summarised as the '3935 campaign', i.e. building a moderately advanced infrastructure system (three plans), enhancing the efficient application demonstration system (nine projects), establishing a solid smart industrial system (three tasks) and developing the environment and security system (five measures)
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
At present, part of ICT resources in Pudong New Area can be shared by different projects. Regarding infrastructure, the data centre that can be shared by different government systems in Pudong and currently many systems is already running in the data centre. As a result, most cameras of public security and city management are shared. With respect to information resources, a database of three key and basic information – population, legal person and geological information – is shared at all levels throughout the district. Business interlinking means the government office network connects all committees, offices and bureaus in Pudong New Area, integrating all administrative work online, and the electronic supervision system can conduct online supervision and inspection of administrative approvals by different departments
Sharing mechanism consists of two aspects. First, scientific methods for projects, which requires regional sharing of information resources as much as possible to avoid duplication of investment, and second, communication and coordination for specific resources, such as webcam resource, underlying database, etc. Pudong New Area has improved the efficiency of government services and optimised urban service functions through infrastructure and information resource sharing

(continued)

The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Low carbon.** It highlights the supporting role of Internet of Things and carries out building energy auditing and sub-metering monitoring in 366 main public buildings by using industrial IoT gateways
Service 2	**Smart public transport.** It can satisfy the travel needs of residents. It provides accurate travel guides for residents via real-time information transfer and also helps to save costs of urban transport
Service 3	**Smart medical care.** It carries out smart medical care pilot projects to promote the establishment of national electronic health records system, which has completed 2.38 million copies of new electronic health records, and gradually achieve the sharing of district-level medical resources. It launches self-help medical services including self-registration, self-charging and self-report printing in the East Hospital, Nanhui Central Hospital, etc., and gradually promotes the services to tier II and III hospitals and community health centres in Pudong
Service 4	**E-government.** It enables government services to be more efficient with its basically built frame system. The integrated information system for administrative examination and approval has achieved online examination and approval on 123 items, committing it to shortening the approval time from statutory 22 working days to an average of 8.4 working days; the underlying databases of demography are already built and the legal person and geographical information can be shared between bureaus, subdistricts and towns
Please describe the measures on organisation, policy, funding and business model of the smart city development	
As for building and organisation, Pudong has established a Smart Pudong building and organisation leadership structure. A working group has been established based on the Leading Group for Pudong New Area Smart City Construction and the Joint Conference for Pudong New Area E-government Construction to promote the Smart Pudong programme by making full use of leadership, decision-making and coordinating functions. At the same time, action plans are established by the district, each bureau, subdistrict, town and development zone according to the progress of Smart Pudong and basic conditions of industries and fields, and relevant work is incorporated in the annual target assessment system	
As for policy support, it has published a 3-year action plan for the Smart Pudong overall planning. It actively studies information resource sharing rules to promote an advanced process, prepares a government procurement catalogue to support mature technologies and products, studies access rules for non-profit applications to encourage social capital investment and introduces a smart city evaluation system to protect construction effect by providing a periodic evaluation basis	
As for capital investment, approximately 30 billion yuan was planned for a 3-year investment according to the 3-year Action Plan for Smart Pudong (2009–2013); 90 % is from social investment. At present, the PPP construction operating model is being explored to attract social investment	
As for business model, it gives priority to social investment under government guidance. Government procurement services, subsidies and other means are used to encourage social capital investment in urban management projects. Enterprises are encouraged to build up a sustainable development model for the projects that have strong market-oriented features and predictable yield through their operations and services	

5.1.4 Yangzhou of Jiangsu Province

The general situation of the economic and social development of the city
Yangzhou City, located in south-central Jiangsu Province, on southern Huaihe Plain and to the north of the Yangtze River, is a city key to the Nanjing Metropolitan Area and Shanghai Economic Zone and a water source to the east route of the national key project South-North Water Transfer
Yangzhou, featuring pleasant environment and beautiful scenery, has won awards such as the United Nations Habitat Award, China Habitat Environment Award, National Environmental Protection Model City, National Civilized City, National Forest City and Chinese Hot Spring City
It has a total area of 6,634 km^2 and a resident population of about 4.6 million. In 2012, Yangzhou's GDP was 293.32 billion yuan, and per capita GDP topped US$10,000 for the first time
In informatisation, Yangzhou has achieved 100 % broadband coverage and 100 % 3G network coverage in the urban area and 4G network starts being built and will provide 4G experience on some buses
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Yangzhou City has developed the Smart City Construction Action Plan which aims to build 'exquisite, happy and innovative Yangzhou' and implement seven special action plans and 28 key projects. Yangzhou will be built through the joint efforts of the whole society into a smart city characterised by sustained economic development and innovation, accurate and efficient urban operations, civilised and convenient public services, safe and comfort city life, modern international tourism and fusion of ancient culture and modern civilisation and become an example to the smart construction of medium and small cities in China
By 2015, the city will achieve 100 % coverage of smart electricity and water meters in new communities, 100 % transportation network information collection coverage on the city roads, 90 % online administrative item coverage, 100 % unified call centre coverage of non-emergency calls, 90 % electronic data interchange coverage in cross-sectorial public work of the government and 100 % and 50 % regional health information platform coverage in the urban and county (city) hospitals, respectively
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
The cloud computing centre of Yangzhou government was built on April 2012. Yangzhou has completed computer room integration in a number of municipal departments and increased online administrative transparency by improving the government cloud computing centre software and hardware construction and promoting resource integration. At the same time, it strives to take the lead in establishing government information resource catalogue and exchange system in the province by building five underlying databases in demographic, geographic, legal person, financial tax statistics and credit fields
Yangzhou has built four smart city application platforms; started construction of government coordination office, city operation supervision and industrial development platforms; integrated and improved the convenient service platform; and promoted citizen card applications. It highlights converged applications of well-being services and urban management projects and makes efforts to promote a number of smart projects
The Yangzhou government cloud computing centre, as cornerstone of the smart city construction, has achieved intensive investment, information sharing and business collaboration in informatisation by promoting infrastructure, data resources and application platform integration around economic development, urban management, well-being and government performance

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Yangzhou comprehensive taxation management sharing platform has established a sound taxation management network by integrating the business-related tax data of government organs and institutions, which has strengthened tax administration, and simultaneously serves as a key platform for Yangzhou government departments to provide e-government data exchange and channel sharing	
In the next few years, Yangzhou will accelerate infrastructure and data resources integration to improve infrastructure. With the cloud computing centre as the basis, the city government will unify the four application platforms of collaborative office, convenient service, city operation supervision and industrial development, which will help to promote projects by classifying and integrating all IT application systems, promote intensive project construction, integrate information resources and make comprehensive development and utilisation, reduce overlapping investment and prevent the recurrence of 'Information Island'	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Government cloud computing centre.** It achieves intensive investment, information sharing and business collaboration in informatisation by promoting infrastructure, data resources and application platform integration around economic development, urban management, well-being and government performance
Service 2	**Comprehensive taxation management sharing platform.** It establishes a sound taxation management network by integrating the business-related tax data of government organs and institutions, which has strengthened tax administration through innovation in collection methods and measures and serves as a key platform for the government departments in e-government data exchange and channel sharing. At present, the data could be exchanged between 49 government departments
Service 3	**Digital city management pilot project.** It innovates in construction modes, operating rules, management mechanism, applied technology, emergency response and mode of expression to create an urban management model of 'one-level supervision, two-level command, three-level management and four-level network'
Service 4	**Intelligent urban public transport.** It develops four business application systems, namely, public transport monitoring and command system, comprehensive analysis system for public transport industry, public transport information dissemination and management system and public transport information service system, to help to enhance service and regulatory standards
Please describe the measures on organisation, policy, funding and business model of the smart city development	
As for building and organisation, a leading informatisation group with principal officials of the municipal party committee and government as the team leaders and officials from the city government and county (city) and district governments as the members has been set up to lead the Smart Yangzhou construction. An expert advice argumentation mechanism composed of domestic and international experts and scholars from well-known enterprises, research institutes, industries and academia has been established to guarantee the high-standard construction of Smart Yangzhou. The Jiangsu Smart City Academy has been built up to study and develop smart city construction standards and application solutions suitable for domestic medium and small cities and promote Smart Yangzhou standardisation and institutionalisation	
As for policy support, Yangzhou has introduced the management measures of informatisation and information resource sharing to strengthen integrated management on smart administration system and ensure overall progress. It has introduced the smart city evaluation system to provide periodic evaluation basis to ensure effectiveness of the construction	

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As for funding, the municipal government sets aside a special fund each year for the government's public information project construction and performance evaluation. It encourages innovation in investment and financing model, through which the government may assist project construction with equity participation or subsidisation to promote social capital investment in informatisation
As for progress model, strategic cooperation agreements signed between the municipal government and telecommunications operators and professional IT service providers enable extensive cooperation in infrastructure, public service applications and other areas through market-oriented means such as BOT/BT

5.1.5 Nantong of Jiangsu Province

The general situation of the economic and social development of the city
Nantong City, Jiangsu Province, as a China's famous historical and cultural city, is one of the first 14 coastal opening-up cities in China. It is located in the southeast of Jiangsu Province and the north of the Yangtze River Delta, neighbouring the Yellow Sea in the east and facing Shanghai across the Yangtze River in the south
Nantong consists of two counties, three cities and four districts, with a total area of 8,001 km^2 and a resident population of 7.63 million. In 2012, Nantong's GDP was 455 billion yuan
The Broadband Nantong and Wireless Nantong programs implemented in recent years enable complete broadband acceleration in the urban areas, wireless broadband network coverage in city hotspots and full coverage of 3G mobile communication network in the urban areas
In the service sector, Nantong actively builds the cloud computing centre of the Su-Tong Science and Technology Park to set up a Nantong-based leading smart green cloud computing data centre that covers central and northern Jiangsu
In addition, Nantong has strengthened the information network facilities construction and information and communication services of major software parks in order to promote software and information service industry development with information infrastructure construction. Nantong seeks to be a modern international port city, north economic centre of the Yangtze River Delta and first-class domestic liveable and entrepreneurial city by relying on the smart city pilot project
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Nantong has developed a series of documents such as the *Smart City Construction Implementation Program*, the *12th Five-Year Plan for Nantong City Informatization* and the *3-year Action Plan for Nantong Information Infrastructure Construction* (2013–2015)
Nantong will become an eco-city featuring green, low-carbon, harmony and sustainable development. Its main objectives are to
Promote management on smart city resources and reduce consumption of energy resources to achieve sustainable urban development and use intelligent transportation technology to build efficient, safe, smart and green integrated regional transport system
Improve the transport system management and operational efficiency
Complete routine community garbage classification and centralised monitoring and treatment to improve recycling rate and reduce waste pollution
Narrow the distance between rural and urban areas to achieve equalisation of public services and improve the happiness and quality of life of residents

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Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Nantong plans to coordinate system resources of different units via the Nantong Smart City Leading Group Office and share the underlying data of ICT infrastructure and coordinates between businesses	
On June 28, 2014, the Nantong municipal government signed the strategic cooperation agreement with Huawei and iSoftStone to develop the national-level smart city project. The project aimed to accelerate the integration and implementation of ICT technologies and enhance the convergence, sharing and use of information resources, using 17 smart city applications, such as smart community, transport, healthcare, tourism and education, covering the economic, social and livelihood aspects	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Smart education.** Starting with the broadband network access to every school, digital resource access to every class, learning resource access to everyone, public service platform for teaching resources and public service platform for education management, it aims to build a smart education system that encompasses all levels and kinds of education around education information technology infrastructure, content development, capacity development, mechanism guarantee and other smart education frameworks in line with Nantong characteristics by reforming teaching model, innovating in learning model and enhancing management level through IT means
Service 2	**Smart transportation.** It has basically completed the transport information infrastructure, with the degree of standardisation of the traffic management system being 80 %. It has built internal and external networks and a transport network to achieve interoperability within the system and developed a number of information systems including traffic portal, office automation system and online system for transparent transportation administration. Nantong is speeding up the construction of Public Transport Information Service Platform
Please describe the measures on organisation, policy, funding and business model of the smart city development	
As for building and organisation, the Nantong Smart City Leading Group, led by the mayor, consisting of officials from government bureaus, has been established for the overall planning and coordination of Smart Nantong	
As for policy support, Nantong gives preferential treatment to the projects involved in the smart city construction in access, tax, water, electricity, gas and other aspects, includes a number of major projects with advanced technologies and strong driver into the city's key project plans and annual implementation plans for promotion and makes use of government guidance to encourage enterprises to increase R&D investment and expand the smart industry through investment, credit, taxation, land and other policy levers	
As for funding, Nantong increases overall investment in smart city construction to innovate in the effective dynamic mechanism for government support funds, seeks to establish special funds and establishes and improves the investment and financing mechanism for multiple stakeholders including government and enterprises to guide banks to increase support to the enterprises participating in smart city construction and their projects	
As for progress model, Nantong actively explores the combination of government guidance and market operation to implement the project construction, operation and maintenance management through in-depth cooperation with city operators	

5.1.6 Huai'an of Jiangsu Province

The general situation of the economic and social development of the city	
Huai'an City, as a city in the Nanjing Metropolitan Area, is located in the north-central Jiangsu Province, eastern Jianghuai Plain and the Yangtze River Delta. Huai'an, standing at the intersection of the ancient Huaihe River and the Beijing-Hangzhou Grand Canal, features convenient transportation and unique regional advantages. It is an important transport hub in Jiangsu and the northern Yangtze River Delta. Huai'an is a China top tourist city, national sanitary city, national garden city, national environmental protection model city and national low-carbon pilot city	
Huai'an has a total area of 10,072 km^2 and a resident population of 4,803,400. In 2012, its GDP was 192.091 billion yuan. Huai'an has achieved co-construction and sharing of systems, platforms and resources of e-government. With Smart Huai'an as the objective, Huai'an accelerates the construction of smart infrastructure, application system, industry and city development environment	
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions	
Its main objectives for smart city building include:	
Environment and energy: excellent air and surface water quality, noise below 70 dB in the daytime and no more than 55 dB at night, effective pollution control, etc. Use of smart water, electricity, gas and other meters, intelligent management of street lamps, etc.	
Transportation: real-time, accurate and efficient transport information service system, traffic management system, public transportation system, vehicle control system, cargo management system, electronic toll collection system, emergency rescue system, etc.	
Waste management: waste collection and transportation intelligent management, waste classification, reduction, safe disposal and recycling	
Combination of urban and rural areas: changes in agricultural development modes, coordinated development of urban and rural economy, acceleration in integration of industrial and urban development, etc.	
Quality of life: people can receive and send all the information of urban life via mobile terminals anytime anywhere, making work, learning, leisure, medical care and other activities more convenient	
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Huai'an is currently building its government cloud computing centre by comprehensively planning the needs of computing and data centres of all the city departments to establish a unified, efficient, energy-saving, safe and stable new generation of cloud platform	
It is planning to build a wireless government network to provide a more reliable and efficient private network	
The land department is building a geospatial information system to standardise the integration of urban space, cadastre, natural resources and other data	
The professional smart city project will be built under a unified planning framework and coordinated by the Smart Huai'an Leading Group Office to strengthen project co-construction and sharing	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Urban public information sharing and exchange platform**. It opens up non-confidential information for living convenience and activates information service industry

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Service 2	**Urban operation and command platform**. It improves the city emergency safety management and public safety and services

Please describe the measures on organisation, policy, funding and business model of the smart city development
As for building and organisation, the Smart Huai'an Leading Group is responsible for construction coordination, and its office is responsible for daily work, unifying key projects and focusing on planning and construction of the city's public basic information service platform
As for capital investment, by 2015, it plans to invest eight billion yuan. Public infrastructure projects are funded by the city government, and professional application systems are funded by the government and enterprises in varying proportions based on different operating models
As for progress model, public infrastructure projects are funded by the government and designed, built and operated by companies according to the government's decisions; professional application systems are funded by system service providers, planned, built and operated by enterprises in a construction and management model selected by government departments and guided by the government

5.1.7 Ningbo of Zhejiang Province

The general situation of the economic and social development of the city
Located in the middle of the coastal line of Chinese Mainland and south of the Yangtze River Delta, **Ningbo** City is one of the five regional centres of the Yangtze River Delta, the economic centre of the south of Yangtze River Delta and Zhejiang Province, an important international portal in Asia-Pacific region, a modern international port city, a famous historical and cultural city of China, a national garden city, a national excellent tourism city and a national civilised city
There are 11 prefecture-level cities under Ningbo City, the sea area is 9,758 km^2, the land area is 9,816 km^2 and the population is about seven million. In 2012, the total GDP of Ningbo City exceeded RMB 650 billion and per capita GDP RMB 85,000
Ningbo presses ahead with the building of 'optical network city' and 'wireless city', strengthens the construction of government affairs cloud computing centre and application databases and reinforces information resource co-construction and sharing mechanism. With the pattern of 'broad network, big data, big platform and great sharing' gradually taking shape, priority is given to building some application systems with intensive wisdom and significant economic and social benefits in line with the concept of 'pilot areas first, demonstration through pilot areas and steady progress'
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Development goals for a smart city of Ningbo are to:
Substantially enhance the administrative efficiency of the government and public service capacity
Provide a more equitable, just, highly efficient and convenient services for businesses and citizens
Significantly improve the scientific building and management of the city
Better allocate urban and rural resources and make significant achievements in the building of an eco-city and energy conservation and emission reduction
The three major application systems of smart logistics, smart health security and smart social management are the areas of distinctive features for the building of a smart city of Ningbo

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Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
The ICT infrastructure of Ningbo has realised data sharing and cross-sector applications in the following three areas:	
First, in terms of basic database of population, the Ningbo Population Data Management Center has been set up. So far, the basic database of population has effectively integrated the population data application systems of six departments, namely, Public Security Bureau, Department of Human Resources and Social Security, Department of Education, Department of Health, Family Planning Department and Department of Civil Affairs	
Secondly, in terms of basic database of legal person entities, such departments as City Commission for Discipline Inspection, City Department of Statistics, City Planning Bureau and City Department of Work Safety have shared the data of legal person entities	
Thirdly, in terms of basic database of natural resources and spatial geographical information, data sharing is achieved for application systems of such departments as Development and Reform Commission, Bureau of Finance, Bureau of Quality Supervision and the Customs	
In terms of smart application, Ningbo City has enhanced management through ICT means and realised business linkage and coordination. Take smart health as an example. Ningbo City has prioritised the building of a smart health system of 'Five Consistencies and Six Tasks' and has initially realised effective integration of excellent healthcare resources	
As an important part of the building of smart logistic system of Ningbo, the smart port of Ningbo has substantially improved productivity through integrating and sharing information resources, optimising business processes and realising refined production management	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Smart health.** Smart health security system is a pilot field for building a smart city. After 2 years of building, we have initially solved the problems of 'difficulty and high cost of getting medical services' and resource allocation imbalance. With deeper progress, it will bring about more economic and social benefit
Service 2	**Smart transportation.** We have conducted data mining analysis of urban transportation data with the technology of big data, improved the scientific planning of the city, enhanced the urban transportation management and reduced transportation pollution emission
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of organisation, we have established a special organisational leadership mechanism and decision-making consultation mechanism. We have set up a leadership group for the pilot projects of building a smart city of Ningbo, coordinated and solved major problems during the building and supervised and put in place various tasks. We have set up an expert consultation committee for the building of smart city and established the Ningbo Academy of Smart City Development to provide decision-making support for the planning and project of smart city of Ningbo	
In terms of policy support, we have rolled out many administrative measures and implementation opinions on the basic database of population, legal person and geographical information and guaranteed the data sharing of basic database. We have formulated the implementation proposals for building an optical network city and integrating three types of networks to guarantee the ICT infrastructure building	
In terms of fund guarantee, we have set up a two-tier investment mechanism for city and prefectures which shall coordinate various supporting funds for the building of a smart city. We have founded a specialised investment operation company to channel more social investment to the building of a smart city	

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In terms of progress model, we are now carrying out 'Free Access Project', which means citizens do not have to pay for the applications resulting in a large demand for the applications, guide the investment of telecom operators and speed up the building of a smart city

5.1.8 Jiaxing of Zhejiang Province

The general situation of the economic and social development of the city
Jiaxing City is located in the southeast coast of China, on the Yangtze River Delta Plain, in the northeast of Zhejiang Province and the vital part of Hangjiahu Plain in Yangtze River Delta. River, sea, lake and stream meet in Jiaxing City, making it the strategic passage in the south of Lake Tai. It has a favourable geographical location, less than 100 km away from Shanghai, Hangzhou, Suzhou and Huzhou
Under the jurisdiction of Jiaxing City are two districts, Nanhu and Xiuzhou; three prefecture-level cities, Pinghu, Haining and Tongxiang; and two towns, Jiashan and Haiyan. It covers an area of 3,915 km^2 with a permanent population of 4.5017 million. In 2012, the total GDP of Jiaxing reached RMB 288.5 billion and per capita GDP of permanent population exceeded 10,000 US dollars
With the support of the Academy of Smart City and Smart City Industry Base, Jiaxing has carried out the building of smart city in such five industries as smart industry, smart service industry, smart agriculture, information industry and smart energy, built a public service platform for the smart city and became the 2012 Zhejiang Province pilot project on smart transportation and smart grid
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Jiaxing City has formulated *Smart City Development Plan (2011–2015)* and the development goals are as follows: by 2015, we should have basically built an integrated and secure information-oriented infrastructure that combines broadband and ubiquitous network; realised widespread smart applications in administration, business and livelihood; and formed the basic framework for the development of a smart city
Jiaxing City proposes that we should build smart application systems in 10 major areas of production and life of the city, including smart government administration, smart livelihood, smart transportation, smart grid, smart health, smart city management, smart culture and education, smart environmental protection, smart logistics and smart tourism
A top-level design reflecting smart cities has been completed that centres around three main areas (government affairs, commerce and general business), three centres (the smart city operation management centre, which is an interactive public data platform, the cloud computing centre responsible for data handling and the intensive data centre responsible for data storage) and ten major applications. At present, the *3-year Action Plan for Smart City Construction (2014–2016)* is being formulated
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Jiaxing City has tried to realise the management and sharing of different smart city projects for its infrastructure. We try to gradually build a public cloud computing data centre, build a cloud computing infrastructure and service platform for various industries in a concentrated way and build a 'wireless city' application data centre and application platform, a platform for sharing the geographical information of digital Jiaxing and a public cloud computing service platform for the government

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In terms of smart city application, Jiaxing city has made efforts in the sharing and opening of information resources as well as business linkage and coordination. In particular, in the city management, we have set up a sound smart city urban management application system through resource integration, approach innovation, function expansion and enhanced digital urban management. In order to further improve the refinement and smart operation of urban management, we have also built an urban management public service platform which is supported by such applications as basic service, data exchange, GIS sharing service, consistent GPS supervision and consistent video monitoring and of which the major functions are digitalised urban management, emergency command, team management, online case handling, decision-making assistance and industry supervision
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

Service 1	**Smart grid.** The first solar photovoltaic civil power generation demonstration base of Zhejiang Province has been set up in Jiaxing and 10,000 households in the pilot projects of FTTH by the State Grid have been directly allocated to the city
Service 2	**Smart transportation**. We have successfully built the taxi on-call centre that covers the whole city and the three-tier transportation network 'Jiaxing Transportation Information Network' that serves the transportation authorities of the province, city and towns

Please describe the measures on organisation, policy, funding and business model of the smart city development
In terms of organisation, we have set up a leadership group and its office for smart city building composed of officials from relevant departments and major city officials. The leadership group is in charge of formulating development strategies and policy planning for the building of smart city, coordinating major issues in development and putting in place various tasks in the building of smart city
In terms of policy support, we have formulated and implemented the *Jiaxing Smart City Development Plan*, drafted such plans as *Jiaxing Smart Grid Plan (General Plan)*, *Proposal of Zhejiang Jiaxing 'Smart City – Smart Grid' Building* and *Jiaxing Smart Transportation Building Implementation Proposal* and guided the overall layout of smart Jiaxing and the implementation of some applications
In terms of fund input, we try to win more fund input through government investment and commercial model of input according to specific needs of different projects

5.1.9 Zhangzhou of Fujian Province

The general situation of the economic and social development of the city
Located in the southernmost part of Fujian Province and between Xiamen and Shantou Special Economic Zone, **Zhangzhou** City is the most important transportation hub in the south of Fujian Province. It is only 50 km away from the Xiamen Airport and the Zhangzhou Port is only 140 sea miles away from to Gaoxiong Port and 287 sea miles away from Hong Kong. With both rivers and sea, the city enjoys rich rainwater and it is like spring all year round. It is the city of fruit and flowers and the base of aquatic products in Fujian or even in China. It is also a famous cultural city with over 1,300 years of history. Only one narrow strait away from Taiwan, it shares the same language, culture and customs with Taiwan
Under its jurisdiction are one prefecture-level city, two districts and eight towns. It covers an area of 12,900 km^2 and a sea area of 18,600 km^2 with a permanent population of 4.8 million. The coastal line of the city is 715 km with over 20 natural deep sea ports and 133 wharves with a capacity of over 10,000 t. The GDP of the city in 2012 was RMB 201.78 billion

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In building a smart city, it has promoted public service programs and formed certain industry clusters by fully leveraging its advantage in the products and businesses of its own enterprises	
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions	
Zhangzhou City has put forwards its plan for smart city infrastructure building and plan for smart city industry application building. Our goals are to build advanced information network facilities, form a relatively complete information resource sharing mechanism and prioritise the building of intelligent transportation system, electronic government administration platform, digital city management platform, city safety camera supervision system, food and drug safety supervision system and convenient service information platform	
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Zhangzhou City has made great progress in infrastructure sharing. It has set up relatively complete basic database in population, legal person, natural resources, spatial geography and macroeconomy. Significant achievements have been made in the building of integrated and specialised databases for information resources in key sectors of economic society. It has also built an information resource sharing and exchange platform for the whole city and its districts and formed a relatively complete information resource sharing mechanism	
In terms of	
Smart city application, Zhangzhou has gradually integrated various resources and realised information sharing and business linkage. As for electronic government administration, with the urban data centre as the carrier, we integrate government IT resources, provide public cloud services and build a cross-departmental 'government administration service platform'	
Digital city management, we have integrated the existing digitalised and information-oriented basic resources; set up a unified platform for comprehensive sensing, digital analysis and information sharing; and coordinated operation in various links of city management, which has comprehensively enhanced and improved city management functions	
Safety camera supervision, we have set up a monitoring platform that covers the whole city, fully integrated video and photo resources inside and outside the Security Bureau, standardised the camera and photo sharing technology and public security photo information database specifications and improved capacity and efficiency of the information storage, handling and comprehensive utilisation of video and photos	
Lastly, through building a convenient service information platform, we have coordinated and integrated relevant information of many departments and social work units to provide a one-stop household expense payment and inquiry service	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Zhangzhou mobile convenient information platform.** We have built an intelligent GPS scheduling system and taxi on-call system for public transport, passenger transport and taxi so that citizens can travel more conveniently. Wireless tourism service provides wireless network access and comprehensive services for tourists at any time and place. We have also built a convenient information platform that integrates job seeking, pricing and tax payment
Service 2	**Convenient fee payment platform.** We provide citizens with a one-stop payment and inquiry service for daily expenses. Through the Internet applications, mobile phone client terminal and cable TV, we provide inquiry services and online payment services for water rate, electricity bill, gas fee, mobile phone fee, cable TV fee, traffic violation fines, social security, public housing fund and individual income tax

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Service 3	**Digital city management.** We have built a spatial data framework that includes such multisource data as multiscale topographic map, shadowgraph, integrated underground pipeline, cadastral inventory, toponymic map and electronic map and set up a comprehensive platform of basic urban geographical information
Service 4	**Smart development zone construction.** We have completed the building of integrated pipeline network information system, specialised subnetwork of water supply and drainage and planning information system for the development zone. Meanwhile, we are pressing ahead with digital remote sensing and 3D modelling, water safety control, smart community and smart emergency projects. In addition, we have built the first artificial intelligent island and designed the urban operation system through new and high technologies and a smart city exhibition hall that integrates smart transportation, smart retail sales, smart energy, smart office and smart residence

Please describe the measures on organisation, policy, funding and business model of the smart city development
In terms of organisation, we have established a smart city leadership group and expert group. The former is headed by the vice mayor with relevant departments such as the Department of Science and Technology, Development and Reform Commission, Department of Economy and Trade, Department of Finance, Public Security Bureau, Department of City Management, Department of Construction, Department of Territory and Department of Planning as the group members
In terms of monetary input, the total investment in information enhancement projects for 3 years after the 12th Five-Year Plan exceeds RMB 2.785 billion, in which RMB 1.606 billion is planned to be invested in information network project, RMB 225 million in public service platform, RMB 516 million in key application projects, RMB 377 million in consumption service projects and RMB 43 million in information security projects
In terms of business model, we have explored various business models in addition to the projects invested and operated by the government. For public-welfare projects, we will provide some support by means of government purchasing according to the needs of the government. During the project operation, if the users need to have frequent telecom added-value projects, individual construction entities shall work with operators with joint investment or investment of operators. The profit and maintenance fee could be recovered through telecom added value during operation at later stages

5.1.10 Yantai of Shandong Province

The general situation of the economic and social development of the city
Located in the east of Shandong Peninsula in Shandong Province with developed economy, **Yantai** City is one of the top 20 cities with strong economic power in China. It is one of the first groups of coastal cities that opened to the outside world. It is an international port city, commercial city and tourism city in Bohai Economic Rim and Northeast Asia. It is a famous historical and cultural city and civilised city in China. It is also the best leisure city and one of the ten most beautiful cities in China. It is known as 'Immortal City of Mountains and Sea'. It is also one of the emerging economic cities with the most investment potential and development vitality
There are six first-class open ports, and Yantai Port is one of the top ten ports in China open to navigation with over 100 ports from 70 countries and regions

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Under its jurisdiction there are six districts, seven prefecture-level cities and one town, covering an area of 13,745 km^2 and a permanent population of 6.503 million. The GDP of Yantai in 2012 reached RMB 528.138 billion
Dominated by the concept of transformation of economic growth mode and structure adjustment, we stick to the strategy of rejuvenating the city through manufacturing industry, beef up the existing flagship enterprises, develop advanced manufacturing industry, lengthen the industry chain to extend the smile curve and speed up the building of a national innovation city
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Yantai City adheres to the principle of 'people first, open platform, service purchase and industrial development', strive to create the smart city brand of 'Smart Yantai' and the smart industry brand of 'Cloud Yantai', in 3–5 years. Great efforts will be made to achieve six major objectives
Higher efficiency of government administration
Better ability to provide public service
Better city management
Faster industrial transformation
Improved eco-environment
Enhance people's happiness index
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Based on the approach of 'government leadership, enterprise investment, professional service and market-based operation', establish Yantai cloud computing centre to provide various smart fields with centralised infrastructure including computer room, network, hardware, security devices, disaster response centre, etc. Make overall considerations for such factors as computing resources, storage resources, network resources, information resources, application support and information security to realise citywide intensive application of non-confidential information resources. Make sure of intensive development, standard service, information sharing and maximised benefits in order to enhance public management and service
With city data sharing system as the underpinning force, set up a city public service platform integrating service portals, integration platforms and operation centres. By standardising the regulations and opening access, provide access service for the management and service applications developed by enterprises and departments of various types, so that the application systems can share data on the platform and coordinate with other relevant applications to serve specific purposes. After applications are accessed, operators can utilise the environment provided by public service platforms, such as ID certification, payment through citizen card, expense settlement, operation and management, to operate the systems and provide services, including e-commerce and online inquiry of and payment for gas, electricity, water and heating
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)
Service 1 | **City public service platform**: set up a city public service platform integrating service portals, integration platforms and operation centres. Enable enterprises and individuals to conveniently and quickly access administrative, public and social services online just like on a shopping website and comprehensively improve information service in the city

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Service 2	**Government cloud centre:** with resource sharing and government affair coordination as the goal, build a city e-government cloud platform in an intensive way. Leverage on the new generation of information technology to develop cloud-based software and hardware infrastructure in a centralised way and gradually realise such functions of e-government as 'infrastructure cloud, application service cloud, information resource cloud and technical service cloud' across the city. Change the current mode that each department develops its own system independently and separately, reduce overlapping investment and make e-government development more efficient and beneficial
Service 3	**Citizen card:** in light of the service concept of 'one card for multiple uses, convenience for citizens', push the project to bring real benefits to citizens. Continue to improve the construction of capital settlement platform for citizen cards, develop multiple payment functions and realise seamless connection of self-service on various carriers, WAP and SMS application. Work faster to expand the functions of citizen card; promote its use for travel, education, entertainment and digital community development; and achieve 'one card for multiple uses' across various fields and industries including entrance guard, drug store, supermarket, cinema and catering. Continue to improve the service system for citizen card, enlarge the scope of its use from five districts to township and county level and expand the scope of card holders from resident population to temporary residents
Service 4	**Sanitation:** centering on residents' electronic health files and medical history, establish a regional sanitation information platform of two levels (city and county); make overall plans to develop such information systems as public health, medical service, new agricultural cooperative, basic medicine system and comprehensive sanitary management, so as to connect all types of medical and sanitary organisations at various levels and share information among them; and form a sound mechanism in which medical and sanitary information resources are shared and businesses are coordinated
Service 5	**Personal files:** build a personal webpage titled 'happy life' for every citizen to record all kinds of information in one's whole life. The webpage also provides characteristic services including online service, intelligent recommendation, vertical searching and socialising, providing all-round information for citizens to deal with matters related to government affairs, personal life and business
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of organisation, form the Yantai smart city leading team to be responsible for promoting smart city construction, smart industry development and information consumption market in an orderly way and summarise and popularise from the results of innovative construction. Improve the mechanism for overall deployment and coordination and intensify the leading team's role as an organiser in multiple aspects throughout the 'smart city' project, such as overall arrangement and coordination, preparation of the action plan, formulation of standards and regulations, macro control during construction, design of assessment indicators and evaluation of results	
In terms of policy support, study and issue a series of favourable and supportive policies for smart city investment and financing, talent introduction and cultivation, enterprise fostering, etc. Issue management methods for smart city projects, integrate projects of departmental information platform construction and make holistic arrangement for the smart city construction capital	

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In terms of business model, encourage and mobilise social force, attract the active participation of various social resources and freely develop smart services on an open platform to jointly build a Smart Yantai. Mitigate the huge amount of basic government capital investment and prevent 'Information Island' caused by independent and separate development. Study policies and measures for service purchase, mobilise all kinds of investors to participate and attract more enterprises to take an active part in building a smart city of Yantai

5.1.11 Guangzhou Nansha District of Guangdong Province

The general situation of the economic and social development of the city
Nansha New District of Guangzhou City is located at the centre of the Pearl River Delta. Within a circumference of 100 km are the most developed city clusters of the Pearl River Delta and two Special Economic Zones. It is only 38 sea miles away from Hong Kong and 41 sea miles away from Macao
There are five international airports around Nansha New District. Nansha New District has successfully built 10 Nansha ports with the berth level of 50,000–100,000 t and formed an integrated transportation system that combines highway, railway, subway and sea routes. It will build a commercial airport
Nansha New District covers an area of 803 km^2 with a permanent population of 148,600. A planned area of a bonded port is 7.06 km^2 and has three functional zones, namely, port zone, logistic zone and processing zone, and is the special supervision area that exercises the right to close the port for management
The GDP of Nansha New District in 2012 amounted to RMB 60.598 billion
Nansha New District will aim at building a national new district with complete cooperation between Guangdong, Hong Kong and Macao to build a new type of model city, high-quality life circle in Guangdong and around Hong Kong and Macao, a new modern industry highland guided by production service industry, a comprehensive service hub up to international standard and an innovative pilot zone for social management service. The wisdom island of Nansha has become the key demonstration project for 'Smart Guangzhou'
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Nansha District has formulated the *Nansha Smart City Top-Level Design Proposal* to guide the building of smart Nansha. With the goal of 'building a high-level, international smart city operation system and creating a new type of model city', we rely on such frontier information technologies as the Internet of Things, cloud computing and intelligent identification; draw on the advanced domestic and overseas experience; build a city control structure featuring resource sharing, smooth circulation, high efficiency and orderliness and a living environment that is safe, convenient and refined; promote scientific, refined and human-friendly social management and embark on a new type of win-win urbanisation path led by the government with social participation
The top-level design for smart city of the district has covered 15 smart applications in the three major fields of city management, livelihood and industry
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

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The infrastructure of the district is managed or shared by different smart city projects, such as specialised network for government administration, government administration cloud, district government administration video access sharing platform and public resources sharing service platform for government administration	
Based on the smart city operation command centre of Nansha District, the routine management and emergency management within the district can be seamlessly combined, and a cross-departmental coordination platform that leads in China has been built with the support of information-oriented business coordination, and hence, all problems, big or small, can be handled fast and orderly like products on an assembly line	
All departments calculate and store resources through government administration cloud sharing and share data through data resource sharing service platform, completely eliminating the possibility of creating isolated Information Island and repeated constructions. Through public resource sharing service platform for government administration, we can effectively collect, exchange, share and apply the information resources in various departments	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Smart public lighting management platform.** The platform has won one international award (finalist in the Innovative Initiative Category at the 2012 Barcelona Smart City Expo World Congress) and six domestic awards (such as High and New Technological Product Certificate of Guangdong Province, Smart City Innovation Application Award of MIIT and Excellent Product Award at the 14th China International Hi-Tech Fair)
Service 2	**Smart family service platform project**. The first phase of the project has been successfully completed. In Nansha District, we have set up three trial areas for high-end users, 500 households of medium-end users and 10,000 households of low-end users with good demonstration effects. The second phase of the project is being prepared
Service 3	**Wireless city project.** Six hundred and thirty Wi-Fi spots have been set up so far in public service areas in the district to provide free service for residents
Service 4	**Smart traffic project.** A demonstration project of green filter road traffic control is completed, which improves road traffic capacity and considerably reduces the number of vehicle stops, traffic delay, fuel consumption and pollutant emission. The construction of 'continuous flow-based intelligent traffic management and control platform' is in progress
Service 5	**Air conditioning energy-conservation project**. Utilising the IoT (Internet of Things) sensing technology to renovate air conditioning systems in buildings, the air conditioning system of the district administration centre has been renovated, resulting in obvious effects of reducing energy consumption by about 30 %
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of organisation, we have set up a 'smart city' working group led by the District Governor with relevant administrative departments involved. The working group is in charge of organisation and coordination of smart city management	
In terms of policy support, we have formulated *Nansha Smart City Top-Level Design Proposal* to guide the building of Smart Nansha	
In terms of fund input, government investment is the main source of capital at the early stage, but active efforts are made to invite private capital at the later stage to establish an operable mode	

5.1.12 Authority of Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone of Shenzhen, Guangdong Province

The general situation of the economic and social development of the city
Qianhai Cooperation Zone is located to the west of Shekou Peninsula in the west of Shenzhen City. Situated by the east estuary of the Pearl River, Qianhai Cooperation Zone stands at the convergence of the principal axis of the Pearl River Delta regional development and the coastal function zone. Not far from Hong Kong and Macao, it is surrounded by Shuangjie River, Yueliangwan Avenue, Mawan Avenue, Bao'an Avenue and the west coast of Qianhai Bay, covering an area of 14.92 km^2 and with a planned population of 300,000. Qianhai District enjoys sound industry foundation and favourable policy environment and has become the test field for reform and opening up
The function of Qianhai is defined as a modern service industry system and mechanism innovation zone, modern service industry development cluster, pilot area for close cooperation between Hong Kong and Mainland China and a leading area in the industrial upgrade of Pearl River Delta. It mainly focuses on such big industries as finance, modern logistics, information service, scientific service and other professional services
Smart Qianhai will stick to the general structure of 'one centre, five horizontals and two verticals' to create a smart Qianhai operation management centre and improve the service interface that gathers people's wisdom and is friendly and interactive, the business system with strong functions and expanded businesses, a support platform with many common features and highly efficient core business, data resources that can be stored in a concentrated way and utilised in a comprehensive manner and an equitable, smooth and open international information infrastructure environment
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Qianhai New District is formulating *General Implementation Proposal for Smart Qianhai*
The eco vision for smart Qianhai is to create a green, low-carbon, human-oriented, liveable and beautiful urban environment; create a complex that integrates smart energy, smart water resources and smart environmental protection and promote the coordinated development of economic society and eco-environment
The transportation vision for Smart Qianhai is to integrate the ITS resources in Shenzhen and Hong Kong and carry forwards the concept of 'integrated road management, integrated and shared information and coordinated scheduling' so that traffic administrators can achieve the great traffic with Shenzhen, Hong Kong, Huizhou and Dongguan
The livelihood vision for Smart Qianhai is to build smart medical care, smart education, smart community, smart home and smart cultural and life service platform and create a smart, convenient, and international living environment
The industry vision for Smart Qianhai is to take Shenzhen-Hong Kong Cooperation and green economy as the development theme to build an international first-class green industry development platform for modern service industry cooperation zone and circular economy and establish a production service industry centre that serves the whole Pearl River Delta and the important base for world service trade
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

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Joint construction and sharing of infrastructure is one of the core concepts for the construction of smart Qianhai. Qianhai Administration has entrusted Jiangsu Posts & Telecommunications Planning and Designing Institute and China Academy of Information and Communications Technology of MIIT to cooperate in formulating the feasibility report and implementation proposal for the joint construction and sharing of infrastructure for smart Qianhai	
Qianhai Administration plans to set up a company which is in charge of the coordination and construction of infrastructure for smart Qianhai. For example, the bottom infrastructures such as data centre, multifunctional sensors and cameras and big local network for Internet of Things can be shared by application projects of different smart cities, and the third party's right to equal access of the shared resources is guaranteed	
Smart water city is a representative business of smart Qianhai. We connect and integrate the whole water system and fully integrate relevant information of Flood Prevention Office, City Meteorological Bureau, Department of Environmental Protection, Department of Transportation, Office of Land and Resources and Seismological Bureau. Through the unified comprehensive management platform for the smart water city, we have achieved coordinated operation of various key systems to a scientific operating state so that in the end, smart water city can realise self-feedback, self-adaption, self-improvement and self-operation	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Smart water city**. We focus on its distinctive feature of 'an integrated water city'; take water culture as the dominant theme; seek support from water safety, water resources and water environment; and use IT means to provide scientific analysis and policymaking support for water-related life of the public in Qianhai
Service 2	**Smart safety.** We adopt the next-generation firewall, SOC safety management, cloud virtualisation and intelligent picture processing technologies to set up an information security guarantee system and a mutually intelligible authentication system. We have also set up an information platform for urban public security and the urban public emergency management platform
Service 3	**Smart transportation.** We adopt the Internet of Things, mobile Internet, big data analysis and advanced navigation and positioning technique to set up the parking resource coordination, sharing and guidance service platform in the CBD of the city, which is the first of its kind in China
Service 4	**Smart communities.** Through such techniques as the Internet of Things, we provide integrated services such as community portal, smart home, virtual community and mobile Internet and create a next-door community service platform that combines community service with smart medical care, smart building and urban emergency services
Service 5	**Smart medical care.** We use picture compression technology and data analysis technology to provide long-distance medical treatment and individual health services and set up a health planning and management system, the public health service and disease prevention information system, epidemic release monitoring system and an emergency command system
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of organisation, we fully rely on Qianhai interdepartmental joint conference, a platform for policy development and support. Qianhai Administration of Shenzhen City has set up the Smart Qianhai Office, which is in charge of the development strategies, plans and policies, pressing ahead with the building of Smart Qianhai and coordinating and solving major problems. A Smart Qianhai Expert Group composed of relevant experts has been set up, providing guidance and argument for the design proposal, engineering project and policy formulation of Smart Qianhai and controlling the macro direction to guarantee that the building of Smart Qianhai is scientific and feasible	

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In terms of fund input, we try to seek for various investment sources including supportive fund from the government finance and set up a specialised fund for the project. Through capital input, loan with discounted interest, financing assurance and service outsourcing subsidies, we try to win more supportive fund from the government and attract social capital including private capital, capital from Hong Kong, Macao and Taiwan and foreign investment. We also raise fund by selling lands, issuing government bonds, carry out cross-border loan and financing in Hong Kong

5.1.13 Zhuhai Hengqin New Area of Guangdong Province

The general situation of the economic and social development of the city
Hengqin New District is located in the area where Hengqin Island is, south of Zhuhai City in Guangdong Province, adjacent to the three islands of Macao and overlooking Hong Kong across the river. It is the only place in Mainland China connecting Hong Kong and Macao via road and bridge and the centre of Southeast Asia and China as an economically booming region
Hengqin New District gives top priority to cooperation, innovation and service and makes full use of its geological advantage of being located at the juncture of Guangdong, Hong Kong and Macao to promote close cooperation and integrated development with Hong Kong and Macao and gradually build itself into a demonstration district of close cooperation between Guangdong and Hong Kong and Macao that drives the development of the Pearl River Delta, serves Hong Kong and Macao and takes the lead in development
Hengqin New District has a total area of 106.46 km^2 and a permanent population of 7,585, and it is planned that by the end of 2020, Hengqin New District will have a total population of 280,000 and per capita GDP of 200,000 yuan
Hengqin New District has planned to start smart city development in tourism and leisure, business services, financial services, scientific and educational development, cultural creativity, high-tech, TCM and healthcare and other industries
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Zhuhai has formulated the *Zhuhai Smart City Master Plan*. According to the plan, after 10–15 years of efforts, Hengqin will be built into an 'open island' connecting Hong Kong and Macao, an economically prosperous and liveable 'vigorous island', a knowledge-intensive, information-developed 'smart island' and a resource-saving and environment-friendly 'eco-island'
With respect to
Environment, Zhuhai will promote green and ecologic urban development and ensure the healthy and sustainable development of Hengqin
Water affairs, Zhuhai will achieve dynamic management of water systems and optimise water resource allocation and water environment governance
Energy, Hengqin will achieve the 'smart, efficient and reliable' intelligent power grid development goal
Transport, Zhuhai will create an integrated Guangdong-Hong Kong-Macao transport model to realise comprehensive intelligent management of all kinds of transport means and comprehensive one-stop information service acquisition in the city
Life quality, Zhuhai will realise integrated food, housing, transport, travel, shopping and entertainment services

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Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
The ICT infrastructures in Hengqin are managed by different smart city projects, with the general hope of achieving unified management and information sharing. For example, Hengqin has established a special communication network company to be responsible for unified construction and operation of new communication networks. Wireless base stations are jointly constructed by the operators under coordination of the non-profit organisations (relevant units for urban construction and management or their dispatched offices, such as the Communications Association) appointed by the government. Twenty wireless base stations have been constructed and shared at the first phase	
Video surveillance, smart sensors and other infrastructures will be constructed and shared in accordance with the product catalogue Hengqin will formulate, the infrastructure construction of each smart city project will be carried out by selecting products from the product catalogue, and perceptual information will be open to the urban public support platform to achieve sharing and unified management of information	
In addition, Hengqin is also positively carrying out joint investment and cooperation, information infrastructure interconnection, high-quality information resource exchange and sharing with the telecom operators in Hong Kong and Macao	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Electronic ring net.** Intelligent video surveillance, precise positioning sensor cable and other new technology portfolios are used to build the closed non-physical electronic surveillance and monitoring network system along the shoreline around the island to provide basic facilities for the customs office to carry out inspection around the island so as to achieve effective supervision of the shoreline around Hengqin Island and prevent and crack down on smuggling and other illegal activities
Service 2	**3C green intelligent transformer substation**s. A number of pilot projects for new technology application are under construction, including distributed energy consumption, micro-grid construction, intelligent power transmission and transformation, power distribution network construction, intelligent power consumption and intelligent support platform construction
Service 3	**Electronic networking project.** IoT monitoring, smart toll-gate control and other IT-based techniques are used to build the intelligent, intensive, safe, stable and efficient electronic networking system that suits the business characteristics of Hengqin New District and meet the needs of enterprises for speedy customs clearance and the needs of customs offices for effective supervision
Service 4	**Digital Hengqin geospatial framework construction project.** It provides a public geographical information and data platform and the data standards and security system for generation, management and updating of geographical information for all departments directly under the government of Hengqin New District to realise geospatial information sharing and exchange
Service 5	**Online service hall.** It realises the connection between the sub-halls at the city and district levels and the online provincial service hall. The city's 1,540 administrative approval items and 406 social service items have been released on the online service hall, realising data synchronisation of the e-government systems at the provincial, city and district levels

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Please describe the measures on organisation, policy, funding and business model of the smart city development
In terms of construction of organisation, Hengqin has adopted the leadership group and expert committee mode. The smart city development leadership group is responsible for making decisions on major issues related to the development of Hengqin Smart Island. Well-known domestic and foreign academicians and experts in smart cities are employed to form the Hengqin Smart Island advisory expert panel to provide important support for the government decision-making
In terms of policy support, Hengqin has promulgated the *Special Plan for Digital Hengqin* and other related documents to carry out planning for the construction of infrastructures in Hengqin. Hengqin intends to formulate the *Overall Design and Action Plan for Hengqin Smart Island* and plans to implement a series of special actions for application and short-term plans. Hengqin has promulgated the policies such as the preferential catalogue for Hengqin's industrial development, customs supervision and tax collection and administration. Hengqin has formulated and implemented the policies for building the national pilot district for talent management reform, promoted the establishment of the credit system and introduced the well-known domestic arbitration institutions
In terms of capital investment, Hengqin has established a stable financial investment guarantee mechanism and a fund management system and is positively striving to gain the relevant fund support from the governments of the state and Guangdong Province. In addition, it has also raised funds through BT, social (private) investments and other financing modes
In terms of process mode, having been positively exploring a variety of business modes, Hengqin has introduced BT/BOT, PPP and other business modes in the information system construction and attracted private capital investment. In this way, enterprises are responsible for the construction, operation and maintenance of information systems, have the ownership of assets as the part of their investment and obtain business income through advertising and value-added services, etc.

5.1.14 Chengdu of Sichuan Province

The general situation of the economic and social development of the city
Situated in the hinterland of West Sichuan Plain, the largest plain in Southwest China, **Chengdu** has a flat terrain, densely distributed rivers and rich natural resources and enjoys a long history, so it has been dubbed as the 'Land of Abundance' since ancient times
Chengdu is the political, economic, cultural, financial, commercial, scientific, educational and logistics centre in Southwest China, a megacity in the upper reaches of the Yangtze River, the city with its citizens having the strongest sense of happiness and the largest aviation distribution centre in inland regions and the integrated transport hub in Southwest China
Chengdu has 9 districts, 4 county-level cities and 6 high-tech zones under its jurisdiction. It covers a total area of 12,300 km^2, including the central urban area of 283.86 km^2, and has a permanent population of 14 million. In 2012, Chengdu's GDP reached 813.89 billion yuan
Chengdu vigorously promotes smart city development, and in terms of smart city technology system, Chengdu has proposed to establish a unified network transmission system, a unified data resource and disaster recovery system, a unified information security system and a unified intelligent application support system. In terms of smart city application system, Chengdu is implementing applications in 6 areas such as smart transportation and trying to establish a smart city operation system

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In 2012, RMB335 billion revenues were created by the main businesses of electronic information industry in Chengdu, of which RMB170.1 billion was from the main business of software and information technology service industry, maintaining an annual average high-speed growth of 40 % for 5 consecutive years. Thirteen out of the world's top 20 software companies have landed in Chengdu, whose revenues from software industry account for more than 5 % of the national total
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Chengdu attaches great importance to developing smart city as an important part of economic and social development and has issued a series of plans and auxiliary policies on such areas as national economy and social informatisation development, construction of communication hubs, Internet of Things, application of cloud computing and development of software and information service industry
Chengdu's smart city development vision is to realise integrated development of informatisation and industrialisation, urbanisation and agricultural modernisation and make significant achievements in smart city development in the aspects of safeguarding and improving people's livelihood, innovating in social management, improving the urban ecological environment, adjusting the industrial structure, improving the policy mechanisms, etc., so as to improve public services and urban management, optimise the industrial systems, protect the ecological environment and improve the development mechanism. The major goals include
Form an urban environment intelligent monitoring system in water resource and other areas and promote eco-city development and make significant achievements in production safety and energy savings in the key industries
Improve travel conditions and reduce traffic congestion
Realise effective supervision of living garbage collection vehicles and all garbage sites
Realise integration of employment services, medical insurance and old-age insurance for urban and rural residents and extend public services to the grassroots level to cover all the residents in the city
Improve the services in travel, health, education, culture, social security and other aspects to significantly improve the living quality of urban and rural residents
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Chengdu implements unified planning, construction and maintenance of information infrastructures in the entire city, and all the projects make full use of the existing information infrastructures such as machine rooms, networks, storage and computing resources
Chengdu has built a unified e-government extranet to provide basic support for various industries. It has made use of the resources in Chengdu cloud computing centre to improve the reliability and survivability of the application systems in various industries, established a government affair information exchange and sharing platform to provide data exchange services for all departments and enhanced the linkage among all departments. By relying on the urban emergency interaction and integrated social service system information platform, Chengdu has realised rapid mobilisation and collaborative law enforcement in handling emergency events. Chengdu provides unified spatial data services and application development interface services for all government agencies, enterprises and public institutions through the e-government geospatial information platform

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Internet and mobile Internet infrastructures are constructed and managed by the telecom operators, the Skynet video network is constructed and managed by Chengdu Public Security Bureau, the intelligent transport video network is constructed and managed by Chengdu Transport Commission and the IoT for food safety supervision is constructed and managed by Chengdu Food Safety Office and shared and used by all departments	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Public safety.** Chengdu has implemented the safety supervision system for major hazard sources (hazardous chemicals) and dynamic supervision for CNG vehicle conversion, gas cylinder life cycle and fireworks
Service 2	**Intelligent transport.** Chengdu has implemented the construction of transport video information acquisition for trunk line networks, transport video surveillance, transport accident detection, transport guidance, the Third Ring Road transport control, signal control system upgrading, the Second Ring Road BRT system and the transport control system
Service 3	**Food safety.** Chengdu has established the meat and vegetable traceability system, and it takes the lead in starting the large-scale, multilevel and all-sided application of the IoT technology in food safety traceability management
Service 4	**Water resource monitoring and management system.** Chengdu has installed sensors at all water monitoring stations and carried out automatic collection and transmission of information such as groundwater level, water pressure and water quality for key rivers, reservoirs and key areas, thus realising automatic monitoring and scientific scheduling and management of water resources, water environment and water security
Service 5	**Promoting energy conservation and emission reduction.** Chengdu has made full use of information technology to reconstruct and upgrade the traditional industries, especially key energy consumption industries, to promote the automation of production process and optimise and promote the rational use of energy system
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of development organisation, led by the informatisation leadership group, the administrative department of informatisation is responsible for overall coordination, and all departments implement the measures, strengthen coordination and cooperation and make concerted efforts to jointly promote smart city development, forming the work pattern and development management system that features 'a leadership group with all relevant departments performing their duties and social forces and enterprises positively participating in'	
In terms of policy support, Chengdu has promulgated a series of implementation opinions and policies to guide the planning and implementation of information infrastructures and applications	
In terms of capital investment, the government has invested and provided financial subsidies to support the basic, public, exemplary, innovative and livelihood projects and attracted social capitals such as private and foreign capitals through capital injection, loan with discounted interest, service outsourcing subsidies and financing guarantees and other forms to participate in smart city development. Information infrastructure projects are mainly invested by the main telecom operators, and the public service platforms are mainly invested by the government	
In terms of progress mode, according to the principle of 'guided by government, relying on enterprises', give play to the market's decisive role in resource allocation and realise full social investment in projects that can be left to the market. Innovate in development mode and completely open the market of government services. Projects that involve people's livelihood and public service shall be undertaken by enterprises, and government will buy services from such projects	

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5.1.15 Korla of Xinjiang Uygur Autonomous Region

The general situation of the economic and social development of the city
Korla City is located at the southern foot of the Tianshan Mountains and the northeastern edge of the Tarim Basin in the hinterland of Xinjiang Uygur Autonomous Region on the alluvial plain of the Peacock River
It is the capital and scientific, political, economic, cultural and educational centre of the Bayingolin Mongolian Autonomous Prefecture. Having jurisdiction over 9 townships, 3 towns, 5 state-owned farming and herding regiments and 5 subdistrict offices, Korla has an administrative area of 7,268 km^2 and city area of 110 km^2 and has a permanent population of 551,500 and a floating population of 400,000
Korla has established the bases for six industries, including oil and natural gas chemical, oilfield equipment manufacturing and technical services, cotton fibre processing, specialty agricultural and sideline product processing, modern energy, mineral products and building materials. Driven by urbanisation and informatisation, Korla has speeded up the development of the service sector and established a multilevel, open, efficient and convenient logistics centre in southern Xinjiang and a key logistics distribution centre in the entire Xinjian
In 2012, Korla's GDP reached 58.1 billion yuan
To promote smart city development, Korla has made full use of digital technologies and related computer technologies and measures to promote all-sided informatisation in urban infrastructures and livelihood development-related aspects and has established the information system with digital network management, service and decision-making functions for urban geography, resources, ecology, environment, demographic, economic, social and other complex systems
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Korla has formulated *Smart Korla Development Master Plan* and *Smart Korla Implementation Plan.* Korla takes 'optical fibre orientation, mobilisation, integration, intelligence orientation and green orientation' as its smart city development concept. By 2015, Korla will realise the following development objectives
The smart city framework will have basically formed, and the broadband, convergence, security and ubiquitous IT infrastructures will have been constructed
Information resources will become important production factors, and trans-sectorial integration, sharing and use of information resources will have been realised
IT applications will be more extensive; innovation and breakthroughs in key areas of urban management and social development, such as transport and community, will have been realised; government operation and urban management will be more intelligent and efficient; and the public services will be more convenient and efficient
The level of IT development in the entire city will be in the leading ranks in West China, the urban comprehensive service capability and quality of the city will have been fully improved, and Korla will become a demonstrative city in the new-model urbanisation in West China
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

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Korla's ICT infrastructures are managed by different smart city projects and shared within a certain range. Among them are the following	
Data centre infrastructures are managed by different departments according to their construction purposes and shared within a certain range	
For geographical information system technology, Korla has established a unified fundamental geographical information system and a public service platform to provide a unified carrier for GIS-based applications in the entire city	
Korla has currently established the fundamental geographical information public service platform and integrated the existing data resources and the existing information systems of all bureaus, commissions and offices to achieve sharing of fundamental geographical information and data and provide fundamental geographical information and data guarantee for IT application in all bureaus, commissions and offices. The platform has been integrated with all business information subsystems to achieve basic data sharing and release	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Fundamental geographical information public service platform.** Korla has integrated the existing data resources and the existing information systems of all bureaus, commissions and offices to achieve sharing of fundamental geographical information and data and provide fundamental geographical information and data guarantee for IT application in all bureaus, commissions and offices. The platform has been integrated with all business information subsystems to achieve basic data sharing and release
Service 2	**Food and drug supervision and management platform.** Korla has achieved safety production and circulation process supervision on rice, flour, oil, vegetables, meat, dairy products, eggs, aquatic products as well as drugs, medical equipment and other key foods and drugs to ensure sustained, stable and good quality and safety of foods and drugs
Service 3	**Community development.** With the help of modern information technologies, Korla has comprehensively improved the level of community management and community services in the entire city and established the grassroots management service centre to provide 'convenient consulting, housekeeping services and home-based aged care' and other community-based services
Service 4	**3D digital city and digital sandbox and 3D auxiliary planning and decision-making system.** Korla has established a 3S-based urban space structure (remote sensing, GIS and GPS) and planned and approved an overall efficient integrated 3D platform to improve its urban quality and planning and management level through digital sandbox auxiliary planning approval
Service 5	**Korla data centre.** It adopts the concept of cloud computing and has good scalability. The data centre currently adopts unified management and allows a number of smart city projects to share the resources
Please describe the measures on organisation, policy, funding and business model of the smart city development	
In terms of development organisation, Korla has established Korla informatisation and 'Smart Korla' development leadership group to organise and promote the implementation of the *Smart Korla Master Plan* and urge all member units to perform their informatisation duties. Korla has established an expert committee to propose measures and opinions on major construction and development issues and carry out argumentation, consulting and technical ruling for major technical issues and technical modification solutions for specific informatisation construction projects	

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In terms of policy support, Korla has formulated *Smart Korla Development Master Plan* and *Smart Korla Implementation Plan* and signed the *Task Plan for National Smart City Development of Korla* with the Ministry of Housing and Urban-Rural Development to provide overall guidance for Korla's smart city development
In terms of capital investment, Korla will invest 111 million yuan for smart city development according to the *Task Plan for National Smart City Development of Korla* signed between Korla and the Ministry of Housing and Urban-Rural Development. There are two main sources of funds: Korla plans to establish a special fund for smart city development to ensure effective fund investment; it will try to gain support from the national, regional and Xinjiang-aid funds and other related support funds and project funds, insist on the principle of interest sharing and full promotion and make use of the market mechanism to fully mobilise and encourage all social forces to participate in smart city development
In terms of progress mode, depending on different projects, Korla has adopted the self-building and self-operation, corporate construction and government lease, BOT, PPP and other business modes

5.2 EU Pilot Smart Cities

The smart city short profiles, provided below, and the assessment of their level of smart city maturity contained in Chap. 6 are based on information provided by the pilot smart cities in the form of 'Smart City Assessment Framework'.

5.2.1 Amsterdam, Netherlands

The general situation of the economic and social development of the city
Amsterdam is the capital city of and the most populous within the Kingdom of the Netherlands. Amsterdam has a population of 810,909 within the city 1,108,297 in the urban region and 1,571,234 in the greater metropolitan area. Many large Dutch institutions have their headquarters there, and 7 of the world's top 500 companies are based in the city. In 2012, Amsterdam was ranked the 2nd best city to live by the Economist Intelligence Unit (EIU) and 12th globally on quality of living by Mercer. The city was previously ranked 3rd in innovation by 2thinknow in the Innovation Cities Index 2009. Amsterdam is the financial and business capital of the Netherlands; it is one of the best European cities in which to locate an international business, ranking fifth in this category
Amsterdam is subdivided into seven 'stadsdelen' (boroughs), a system that was implemented in the 1980s to improve local governance. Local decisions are made at the borough level, and only affairs pertaining to the whole city, such as major infrastructure projects, are handled by the central city council
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

(continued)

Amsterdam is an international frontrunner in the development of smart city development. The Amsterdam Smart City programme (ASC) was set up in 2009 to stimulate innovation in energy and connectivity. ASC's focus is on the themes of living, working, mobility, public facilities and open data. ASC is about the total sum of testing innovative products and services, understanding the behaviour of the residents and users of the Amsterdam Metropolitan Area and sustainable economic investments. The ultimate goal of all activities is to contribute positively towards achieving CO2 emission targets, as well as aiding the economic development of the Amsterdam Metropolitan Area	
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Connectivity is an important aspect of a smart city. Investments in fibre-optic networks and other basic ICT infrastructures are generally taken care of by the municipality. Infrastructure can also be provided by the partners in a project	
The Amsterdam Internet Exchange (AMS-IX) is the world's second-largest node of cables serving the data sharing infrastructure of the World Wide Web. It has an average throughput of 593 Gbit per second. This has proven a great asset in attracting companies that take advantage of high-speed communications. Eighty-nine percent of people in Amsterdam have a direct Internet connection. Internet usage in the Netherlands is among the top three in the world. There is Wi-Fi coverage throughout much of the city, especially at cafés and coffee shops	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
A comprehensive documentation of activities and projects under the roof of the ASC initiative can be found at the ASC website http://amsterdamsmartcity.com/	
Service 1	**Almere:** create a 'smart society' with the Almere Economic Development Board through smarter deployment of ICT, people and resources in urban management and development. The Almere Smart Society vision involves the realisation of an ICT facility which will promote more efficient urban management, innovation and economic growth, strong social cohesion and sustainable development
Service 2	**Smart Work@IJburg:** Smart Work centre is built near the homes of the employees that are normally stuck in the traffic jams, payment system, Smart Work centres with Telepresence system, awareness campaign
Service 3	**TrafficLink's SCM system** is connected to the traffic system of the national government. The centres can jointly and automatically manage traffic within the region. The system can easily be prepared for connection with in-car and navigation equipment. In the future, a modern digital road manager is foreseen to help optimize traffic flow within the whole region
Service 4	**Nieuw-West smart grid:** 10,000 out of the 40,000 households are served by Alliander's new smart grid. Nieuw-West has a high penetration of smart meters and contains the largest amount of solar panels in Amsterdam. Participating companies focus among others on innovations in the field of e-mobility, large-scale generation of solar power by consumers and discharge to the grid, small-scale balancing of demand, vehicle to grid, etc.
Service 5	**Open data:** Apps for Amsterdam 2 is the second open data contest of the municipality of Amsterdam in which developers are challenged to build apps based on the municipality's data in the areas of safety, mobility, vacancy, energy, tourism and culture and democracy
Please describe the measures on organisation, policy, funding and business model of the smart city development	

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Amsterdam Smart City (ASC) is a partnership between businesses, authorities, research institutions and the people of Amsterdam. It was initiated by the Amsterdam Economic Board, the City of Amsterdam, Liander and KPN. The source of funding is from these partners, each contributing to the total yearly budget of €400,000. This includes all cost incurred by the programme, including salaries. Per project there is a business model, since projects are not funded and need to earn themselves back
ASC has grown into a broad platform, with more than 100 partners that are involved in a variety of projects focusing on energy transition and open connectivity in the area of living, working, mobility, open data and public facilities such as healthcare and education
ASC is all about the total sum of testing innovative products and services, understanding the behaviour of the residents and users of the Amsterdam Metropolitan Area and sustainable economic investments. By using a collective approach by bringing partners together and setting up local projects, ASC makes it possible to test new initiatives. The most effective initiatives can then be implemented on a larger scale. All the acquired knowledge and experience is shared via the ASC platform. The ultimate goal of all activities is to improve the quality of life of the inhabitants, as well as aiding the economic development of the Amsterdam Metropolitan Area
Amsterdam Smart City has designated three urban living labs to test various products and services and to combine activities: Nieuw-West, IJburg and Zuidoost
The municipality of Amsterdam experiments with crowdsourcing on the platform AmsterdamOpent.nl to learn how to interact with civilians to support local policies. In addition to the website www.amsterdamopent.nl, there is also a Facebook application which allows users with a Facebook profile to submit their ideas by Facebook

5.2.2 Barcelona, Spain

The general situation of the economic and social development of the city
 **Barcelona**[2] is the capital of the autonomous community of Catalonia and the second-largest city in the country, with a population of more than six million and about five million people in its metropolitan area. Barcelona is one of the world's leading tourist, economic, trade fair/exhibitions and cultural-sports centres. It is the fourth economically powerful city by GDP in the European Union and 35th in the world with an output amounting to €177 billion (44 % more than the EU average). The Barcelona metropolitan area comprises over 66 % of the people of Catalonia, one of the richest regions in Europe, with a GDP per capita of €28,400 (16 % above EU average). Barcelona occupies the 13th place in the world on *Innovation Cities Global Index*
Barcelona has a twinning agreement with Shanghai since 2001
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
The long-term vision of Barcelona is based on building a city of productive, human-scale neighbourhoods within a hyperconnected, high-speed and zero-emission metropolis

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The MESSI strategy summarises the city's ICT strategic plan: mobility, e-administration, smart city, systems of information and innovation. In 2011, the mayor included the smart cities topic in the city strategy for the new tenure as a key strategic point. The key areas of the smart city efforts are directed towards environment and energy, transport, waste management, urban-rural cohesion and quality of life. Also, the mobility master plan provides an important framework for the city's transportation development
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
One of Barcelona's main goals is to work on the installation of a 500 km fibre-optic municipal network, providing FTTH covering 90 % of the city (500 km at 1 Gbps). The main investment being made by the city council is in networks integration. The city is working on an exploitation and unified network management model so that it can be offered to other city services and be opened to others, exploiting the excess of capacity in exchange of obtaining new funds for its management and maintenance. These telecommunication infrastructures are offered to the rest of infrastructures and specific services of every business area since ICT infrastructures are transversal (through networks, management platforms, control and management systems)
Barcelona Wi-Fi is a free Internet access network available to all citizens (443 Wi-Fi antennas)
The current models of provision and ICT services at the municipal level have gradually move towards a more sustainable, relying on more efficient technologies such as the cloud, using standards and sharing service. For example, Barcelona engaged Microsoft partner Bismart to create a storage solution that runs in a hybrid cloud. Based on Windows Azure, Windows Azure HDInsight Service and SQL Server 2012, the solution collects and examines big data from city and public sources
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

Service 1	Intelligent traffic data management, with the creation of a situation room to control the city from one single centre (ready in 2013)
Service 2	Open government project, based on the promotion of citizen participation, cooperation and transparency, especially making public data and infrastructures available (2012) (Open Data, OVAC, e-administration)
Service 3	Development of energy efficiency in buildings based on the incorporation of solar panels, mixed uses, joint heating and water recycling under the framework of energetic self-sufficiency plan (self-sufficient building blocks, smart grid, heating and cooling network)
Service 4	Smart Innovation includes the following projects: Innovation District 22@, Smart City Campus, Smart City Tour, Smart City Cluster, Urban Lab and Competence Center mSmart City. Urban Lab, 2008, is a tool created to allow the use of public space for companies to test solutions and services in a real urban environment
Service 5	Development of an urban platform for city management to unify data from various sources (this project will be ready in 2014) which includes the projects: CityOS, Barcelona Sensors Platform and i-City

Please describe the measures on organisation, policy, funding and business model of the smart city development
The city council was a new department called Urban Habitat, under which several areas of the city were grouped: urban planning, ICT, energy, environment, urban services, infrastructure, etc. A coordination team, led by the new Smart Cities Director, was set up and works dedicated to find synergies among the projects comprised in this smart city strategy altogether and ensures their alignment with this long-term vision of the city

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Barcelona City Council has signed strategic collaboration agreements with corporations such as Cisco Systems, GDF Suez, Telefonica, HP, Abertis or Schneider Electric, and others. Other partners are the EU Commission, World Bank and United Nations
The city has a large trajectory of citizens' involvement in the shaping of policies. Some examples could be the participative process of the 4-year Municipal Action Plan in which more than 70,000 contributions were received or the signing of the citizens' compromise for sustainability that was approved with the implication of more than 800 civil entities
The city is working on a project based on World Bank indicators called 'bigov Better City Indicators' aiming to define the main indicators needed for building a city profile. This project is developed hand in hand with private sectors, including big multinationals and local SMEs. The city also has its own KPI monthly report to follow the performance in every area; those indicators are based on standards. Barcelona is collaborating jointly with the City of Buenos Aires in the innovative project of the 'Smart City Index'
Generally, the city council itself is in charge of the projects and external partners are usually channelled by a public bidding process. Besides this, developer partners are linked to free software standards and I+D agreement partners are subject to the established clauses regarding investments and task responsibilities of each partner
It is important for Barcelona to share their experiences in developing smart city projects with other cities across the world, academia and industry. They see dialogue as central in spreading learning and maximising the benefit and value of their work. The City Protocol is a discussion space to talk about cities across sectors, http://cityprotocol.org/index.html
The city has signed agreements with a number of companies and other partners such as Cisco, Schneider Electric, GDF Suez, BDigital, Barcelona Design Innovation Cluster, IREC, i2cat, Dublin City Council, Buenos Aires Gobierno de la Ciudad, Ajuntament de Sant Cugat, City of Yokohama, Fundación Metropoli, Seoul Metropolitan Government and Ayuntamiento de Bilbao. Private companies usually contribute to the project funding by resources provision, sometimes capital contributions. Projects may be either integrally financed by the city council or financed through PPP. The city council funding may range from 100 % in integrally self-financed projects to a percentage that can be very variable depending on the project when it comes from partnerships (usually >50 %)
There are also public biddings incorporating smart elements so that smart structures funding is supported by the chosen company. There is also the possibility of funding coming from the EU through innovation projects. It is normally a co-funding system which implies a mix between PPP and public biddings

[2] Source: http://en.wikipedia.org/wiki/Barcelona.

5.2.3 *Bristol, UK*

The general situation of the economic and social development of the city
 **Bristol**[3] is a city and unitary authority area in South West England, with an estimated population of 433,100 for the unitary authority in 2009 and a surrounding larger urban zone (LUZ) with an estimated 1,070,000 residents in 2007. It is England's sixth and the UKs eighth most populous city, one of the Core Cities Group and the most populous city in South West England. In more recent years the economy has depended on the creative media, electronics and aerospace industries, and the city centre docks have been regenerated as a centre of heritage and culture
In 2004, Bristol's GDP was £9,439 billion, while the combined GDP of Gloucestershire, Wiltshire and North Somerset was £44,098 billion. The GDP per head was £23,962 (€35,124) making the city more affluent than the UK as a whole, at 40 % above the national average and the third-highest per capita GDP of any English city. In March 2007, Bristol's unemployment rate was 4.8 %, compared with 4.0 % for the South West and 5.5 % for England
Bristol has a twinning agreement with Guangzhou since 2001
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Smart City Bristol is a collaborative programme between the public sector, business and community. The aim is to use smart technologies to meet the city's target to reduce CO2 emissions by 40 % by 2020 from a 2005 baseline, as well as the city's wider social and economic objectives. It was launched in 2011 and builds upon the **Smart City Bristol Report** commissioned by Bristol City Council and funded by the UK Department of Energy and Climate Change. The Bristol smart city programme currently focuses on smart energy (smart metering, smart grid, smart public buildings and smart energy master planning), smart transport (traffic control centre, electric vehicles, freight consolidation centre), smart data (city open data platform, innovation work with SMEs, communities, art projects, etc.)
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Bristol City Council owns and manages a £9 million city fibre-optic network (B-Net) and is one of the UK's 'Super Connected Cities'. The UK Government is investing £11 m in Gigabit Bristol which will deliver a high-speed broadband research network, citywide Wi-Fi and RF mesh network. The city council also runs its own data centres, emergency control centre including CCTV and telecare and traffic control centre and has a GIS team
In December 2013 Bristol received £4.8 million to help small- and medium-sized businesses upgrade to a high-speed and high-grade broadband connection. Connection vouchers cover the upfront capital cost of broadband installation up to the value of £3,000. Bristol businesses are eligible to apply for the connection vouchers, providing they have less than 250 employees, a turnover of less than £40 m and meet EU 'de minimis' criteria[4]
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

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Service 1	**Digital Environment Home Energy Management System (DEHEMS)**: the project was how technology can improve domestic energy efficiency. The project partnership included a mix of European local authorities, private business and universities. The intention was to develop and test a home energy management system with the aim of improving the current monitoring approach to levels of energy being used by households in order to reduce CO_2 emissions. In Bristol the smart metering technology was deployed in 50 social houses in Knowle West
Service 2	**3e-Houses:** the project consists of integrating the most common ICTs into social housing in order to allow homes to save energy, shift their consumption from peak to off-peak hours and reduce CO_2 emissions. The project promotes energy saving by helping users to find out how and how much they consume by using the most common ICTs applied to energy consumption. It offered real-time monitoring and management of the energy consumption, integration of renewable energies and development of tools for designing and evaluating energy-saving plans. 3e-Houses were deployed in social housing in Germany and Spain in 2010 and were replicated in Bristol in 2012. In Bristol 100 social houses participated in the project and partners worked with them in a collaborative approach building on the finding from DEHEMS
Service 3	**ICT services for Electric Vehicle Enhancing the User experience (ICT 4 EVEU):** the project aims to deploy an innovative set of ICT services for electric vehicles in pilots across Europe. The scope of the ICT services is the integration of different management systems operating on the existing EV infrastructures in the cities where the pilots will be run, so that related services can be deployed and make use of these interconnected infrastructures (charging points, control centres and vehicles). The pilots will be based in a growing, geographically speaking, scope. The main services for the users will be the reservation of charging points in advance, creation of an interactive map or charging points for drivers, review of charging reports, SMS notifications and communication with energy suppliers, among others. The services will be accessed through website or/and via smart phones
Service 4	**Urban Traffic Control Centre (UTCC):** the centre now uses more than 200 cameras to monitor vehicular movements throughout the city, linked to the remote communications and equipment room via the council's own fibre-optic network (B-Net); the images are displayed for operators on a large rear-projection video wall. Information from sensors which monitor how many vehicles pass certain points is fed back into the system which can alter signals to allow traffic to flow more freely. Bristol is exploring how to open up the data collected so that communities and organisations can make use of it in creative ways including supporting sustainable transport initiatives
Service 5	**B-Open Datastore:** the aim of this open data portal is to promote transparency and increase public and neighbourhood engagement, making it easier to share information with citizens, encouraging them to work with information and data to create applications, websites, mobile products or installations. In 2010 the Bristol City Council, in partnership with the Watershed, supported a Media Sandbox Competition which centred on the creation of ideas that explore rich experiences augmented by open data or mobile, wireless and sensory technologies
Please describe the measures on organisation, policy, funding and business model of the smart city development	

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The smart city programme is led by the city council. Currently within the city council, the work is led by Bristol Futures, which brings together the council's work on environment, digital, economic and international work. There is a consortium of organisations (public, private and community sector) who work together on funding bids, projects, etc. Recently some smart city business development work has been commissioned to do an appraisal of different business models for commercialising smart city services; to identify the best business model for Bristol including how it can capitalise on the city's existing smart city assets (e.g. digital infrastructure), skills and partnerships; to identify financing mechanisms; and to develop a business plan. As part of this the city will look at the best governance structure to deliver the business model and identification of the role of the city council and other partners would play within this
Bristol has a strong public, private and people partnership approach to smart city work, with support from the city's universities, businesses, public sector, community partners and citizens. There is a stakeholder group of more than 100 people who have been involved in Bristol's smart city work; this includes representatives from Bristol City Council, University of Bristol, University of the West of England, Toshiba, IBM, Arup, HP, Clean Energy Prospector, Open Knowledge Foundation, NHS, Technology Strategy Board, the national government (e.g. UKTI), the European Commission, EUROCITIES, other European/international cities, citizens of Bristol, etc.
The smart city programme is funded through sources such as the city council budget and funding from the European Commission, UK government, Technology Strategy Board and UK Research Councils and private company funding. There are around £5 m for current/recently completed smart city projects and £11 m for digital infrastructure (Gigabit Bristol). The Future City Demonstrator received £3 million from the UK Technology Strategy Board in 2013 to create environmental and socially sustainable jobs and growth through data integration projects
A metrics programme is under development to measure progress of the smart city programme as part of the Future City Demonstrator work. Some individual projects, e.g. smart metering, have its own metrics. There are also KPIs for the wider sustainability agenda for environment, energy, transport, quality of life, etc.

[3] Source: http://en.wikipedia.org/wiki/Bristol.

[4] http://www.bristolmedia.co.uk/news/1674/bristol-receives-48-million-of-funding-to-help-smes-gain-access-to-high-grade-high-speed-broadband#.UtOxFc-Dpjo.

5.2.4 Copenhagen, Denmark

The general situation of the economic and social development of the city
 **Copenhagen**[5] is the capital and most populous City of Denmark, with an urban population of 1,230,728 and a metropolitan population of 1,967,727 (October 2013). It is the economic and financial centre of Denmark and a major business centre for the entire Scandinavian-Baltic region. In 2010, of the 350,000 people working in Copenhagen, the vast majority were employed in the service sector, especially transport and communications, trade and finance, while less than 10,000 work in the manufacturing industries. The public sector workforce is around 110,000, including education and healthcare

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From 2006 to 2011, the economy grew by 2.5 % in Copenhagen and Copenhagen Municipality, while it fell by some 4 % in the rest of Denmark. In 2012, Copenhagen was third in the ranking of the richest cities in the world in terms of gross earnings (but dropping from first place in 2009). The city also has successful business clusters in several innovative sectors including information technology, biotechnology, pharmaceuticals and clean technology
Copenhagen has established a reputation as one of the world's greenest city, leading the Siemens Green City Index for Europe. The city has also been selected as the European Green Capital for 2014
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
The city council on Copenhagen has in 2013 decided to develop a smart city strategy and start an administrative smart city board for smart city initiatives, which is now coordinating all smart city initiatives across the seven administrations. The main focus is on working with open data and the establishment of a digital infrastructure in the city related to 50 % rollout of new LED-based street lighting in the city. Furthermore smart city initiatives are included in different other policies and political adopted plans. The city administration has for the last years worked with smart city and smart data solutions, involving several of the city's administration, including financial, technical and environment, and healthcare administrations. It has adopted a climate action plan to provide initiatives concerning storm and sewage water and work has begun on a smart city reference architecture to align adopted climate strategies with business processes and technology crosscutting vertical business domains in the city facilitated by Copenhagen Solutions Lab (CSL)
CSL is a joint smart city approach, involving large companies, SMEs and research institutions. The aim is to provide tangible solutions to tangible problems. The CSL effort will be centred around three lines:
1. Dialogue/meeting place/contact centre – guide to data, new technology and issues to be solved in the city
2. Eksperimentarium – concrete solutions
3. Demonstration and dissemination centre
Copenhagen has an ambition to become the first carbon-neutral capital in 2025. The goal is supported by a municipal strategic climate action plan where 50 initiatives are rolled out to meet the 2015 midterm goal of a 20 % CO_2 reduction. Studies from Copenhagen show that growth in the green sector in the capital region has increased turnover by 55 % over a course of 5 years. The city already has one of the lowest carbon footprints per capita in the world (less than 2 t per capita).
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Copenhagen is currently participating in a vast array of initiatives and planning, directed towards the establishment of an ICT infrastructure. The list includes Copenhagen Connecting, a digital infrastructure for the city; Copenhagen Cleantech Cluster, creating a marketplace for open data in cooperation with private partners, organisations and universities; Øresund smart city hub and more
Copenhagen has engaged in a consortium with two green capitals of Europe (Hamburg and Nantes) and other five European cities to send in an application for Horizon 2020 SSC-01 smart cities and communities. The lighthouse project in Copenhagen will establish a large-scale demonstration area in the city centre, with a first-of-its-kind digital infrastructure that connects mobility and energy solutions by leveraging the light post as the new innovative 'hub' for a consolidated implementation and coordination of different assets using chip and Wi-Fi triangulation and an infrastructure for smart energy metering and control for industries and private households

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More initiatives include the GIS platform and the open data distribution platform, plus the just politically decided ITS platform for 'intelligent handling of traffic' to be implemented fully over the next 3 years, with a budget of 60mio. DKK

The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	GIS platform (http://kbhkort.kk.dk/)
Service 2	Establishment of Copenhagen Solutions Lab in 2014
Service 3	Copenhagen Connecting, intelligent street lighting that eventually will allow for first-of-its-kind smart city digital infrastructure (http://copenhagenconnecting.com)
Service 4	ITS platform for 'intelligent handling of traffic' to be implemented fully over the next 3 years, with a budget of 60mio. DKK
Service 5	Increased mobility through integrated transport and cycling solutions has reduced congestion significantly and increased health of the citizens

Please describe the measures on organisation, policy, funding and business model of the smart city development
Involved stakeholders are both at political and administrative levels, such as land and property developers, universities, providers of electricity, water and sewer company, energy providers, grid companies, transport companies, etc. Citizens are not systematically involved
In connection with an EU FP7 co-funded project 'TRANSFORMation agenda for Low Carbon Cities', a set of KPIs have been established. The City of Copenhagen has participated in the C40 city analysis and been among cities chosen for the Siemens Green City Index. In Copenhagen urban green solutions are already implemented in large scale in the city, used by everyday people, and have had significant effects on CO_2 emissions and city liveability
No specific funding has been provided to smart city development. Some minor funding has been provided for some open data source projects for the coming years. In most cases the smart city initiatives are included in other projects as means or tools to achieve the desired results
The city has placed public-private partnerships at the core of its approach to eco-innovation and sustainable employment by working closely with companies, universities and organisations to develop and implement green growth. Its North Harbour project, for example, includes a 'green laboratory' that will focus on eco-technologies, a model that can be transferred to other towns and cities[6]

[5] Source: http://en.wikipedia.org/wiki/Copenhagen.

[6] Source: 'The Networked Society CityIndex 2013', Ericsson.

5.2.5 *Florence, Italy*

The general situation of the economic and social development of the city
 **Florence** is the capital city of the Italian Region of Tuscany and of the Province of Florence. It is the most populous city in Tuscany, with approximately 370,000 inhabitants, expanding to over 1.5 million in the metropolitan area

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Florence's historic centre attracts millions of tourists each year; it was ranked the world's 72nd most visited in 2009, with 1,685,000 visitors, and is believed to have the greatest concentration of art in the world. It was declared a UNESCO World Heritage Site in 1982. It is also ranked within the top fifty fashion capitals of the world. Especially the tourism and fashion industry make it one of Italy's major national economic centre. In 2008, the city had the 17th highest average income in Italy (€23,265)

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

Florence is currently developing a new smart city vision and strategy. From the mobility supervisors to intelligent lighting systems, open data strategy, digital services for citizens and tourists and to electric mobility, the city is proactively developing a strategy of commitment to innovation, where the core idea is the system of interactions between the physical and human layer, on the one hand, and the digital layer, on the other hand

The goal is to create a green, low-carbon, human-oriented environment through a sustainable development with new technologies. In 2010 the mayor of Florence joined the Covenant of Mayors with the aim to go beyond the objectives of EU energy policy in terms of reduction in CO_2 emissions through enhanced energy efficiency, intelligent mobility and cleaner energy production. The city has already adopted an Urban Traffic Plan which is triggering many changes regarding mobility, such as the construction of two additional tramway lines and the use of advanced technologies to improve the traffic management capacities and to give exhaustive real-time information to travellers and PT users. The city has decided to bid over the electrical mobility to become a reference point at a national and international level in the diffusion of electrical mobility in terms of quantity and quality. Its master plan of electric mobility has the objectives of a fleet composed of 10 % of electric cars or plug-in hybrid cars and 20 % of electric motorcycle and electric scooters in 2020. It has over 20,000 electric cars, 2,000 light commercial vehicles and 11,000 motorcycles and scooters

Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

The city has more than 160 km of fibre-optic network connecting city functions such as CCTV cameras or government intranet. The Firenze Wi-Fi network offers more than 500 federated Wi-Fi hotspots that provide free access for 2 h/day for residents and visitors. A citywide sensor network supplies data to the traffic management centre and for security monitoring. An open data platform offers more than 500 datasets in a machine-readable formats for reuse by the public. On more than 40 public 'digital signage' displays, latest information is provided through the city digital system

The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

Service 1	**Smart lighting:** the Cascine park, the biggest green area of the city, is going to have the first Italian smart lighting project in a green area completed by April 2014. The underlying theme of the project is the use of advanced technologies related to lighting (lighting with LED sources) with the benefit of energy savings and reduced environmental impact
Service 2	**ELECTRA:** the core concept of the project is that it is possible to reduce pollution due to passenger transports and improve quality of life by promoting a new urban sustainable mobility model. In this light, the project allows to increase the electric scooter use in urban areas, through short sharing (e.g. for 1 day) or rent (e.g. for 6 months), in order to achieve by 2020 a modal electric scooters share can be acquired equal to 1 % of house-work/school daily trips (= about 4.700 daily trips in less in a urban area with one million of inhabitants)

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Service 3	**Open data:** Florence has launched a section of its website dedicated to recently released mobile apps. Based on Florence's open data, some are produced by the city, others by independent developers, all are free, e.g., Florence Heritage is a collection of information about elements of the city that contribute to its UNESCO World Heritage status, including historic shops and palazzi. There are itineraries and in-depth information available FirenzeUp connects to the city's events database and is up to date with everything happening, which can be filtered as 'Around You' or 'Top Rated' Firenze the Walking City suggests historic and panoramic walking itineraries around Florence, with photos, elevation and a quick description along the way, including a guide to open Wi-Fi hotspots Firenze Card App is a complement to the 3-day museum card; the app shows all the museums and events on a map, as well as the city's information points and Wi-Fi locations
Service 4	**GEO** is a service of geo-referencing information resources in the field of mobility, experimentally developed in 2011 by the City Line Spa. It provides access to a family of related services to the mobility and provides real-time traffic situation of Florence. Currently in GEOmobi it is possible to see construction work, accidents, speed cameras, detours, etc. GEO will be extended to other areas and services, e.g.: GeoWash, which are surveyed map on the days and hours of street cleaning planned by municipalities for each road Geopark, which enables users to check the parking situation and also the number of parking places available

Please describe the measures on organisation, policy, funding and business model of the smart city development

The smart city programme is led by the municipality, both political and administrative levels. Other stakeholders are public organisations such as the Tuscan Region, the Province of Florence, universities and research institutes. External partners are usually channelled by a public bidding process. Cooperation agreements are in progress with Enel, with Nissan-Renault and with Arval (on the subject of long-term rental), in addition to numerous collaborations (Piaggio, Mercedes, Smart, NWG, Ducati Energia, Bosch, etc.). The city has established a structured way of encouraging citizen participation in the decision-making about city matters. '100 Luoghi' (100 places) allows citizens to contribute in a practical way to the reorganisation, construction or improvement of parts of the city like squares, gardens, schools, parks, infrastructure, etc. The 100 places are divided in different thematic areas such as school, green city, historical downtown, society, etc. Every year 100 meetings take place simultaneously in 100 different locations of the city. An app for smartphones has been created in order to propose ideas, point out problems and find initiatives sending photos and comments. The app allows citizens to download progress reports. Citizens can use also the municipality website to post comments and photos

Currently KPIs are not systematically used by the city to measure smart city performance, but there are some tools that allow tracking of programme activities and results. In particular, the strategic monitoring system notes the results following the strategic objectives of planning guidelines to the mayor's mandate and the forward and programmed planning. The monitoring provides an ongoing assessment of the programmes' implementation progress and the degree of achieving its stated goals and objectives. It incrementally tracks programme progress as it is implemented

No specific funding has been provided to smart city development. In most cases the smart city initiatives are included in other projects, where there is a mix of municipal, regional and national government funding, European funds, revenues from buildings sales and sponsoring

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5.2.6 *Frankfurt, Germany*

The general situation of the economic and social development of the city
 **Frankfurt am Main** is the fifth-largest city in Germany, with a population of 687,775 (2012). The actual urban area has a population of 2,500,000. The city is at the centre of the larger Frankfurt Rhine-Main Metropolitan Region which has a population of 5,600,000 and is Germany's second-largest metropolitan region. Frankfurt is the largest financial centre in continental Europe and ranks among the world's leading financial centres. Frankfurt is a major air, rail and highway transport hub. Frankfurt Airport is one of the world's busiest international airports by passenger traffic. Frankfurt Central Station is one of the largest terminal stations in Europe. Frankfurt is also a centre for commerce, culture, education, tourism and web traffic. Messe Frankfurt is one of the world's largest trade fairs and convention centres. Frankfurt is among Europe's most international cities, with nearly 25 % of residents being foreign nationals. Forty percent of residents, and 65 % of those below the age of five, come from an immigrant background
According to the European Cities Monitor (2010), Frankfurt has been one of the top three cities for international companies in Europe, along with London and Paris, since the survey started in 1990. It is also the only German city considered to be an alpha world city (category 3) as listed by the Loughborough University group's 2010 inventory
Frankfurt is also home to DE-CIX, the world's largest Internet traffic exchange point
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Frankfurt approaches the smart city topic from a dedicated 'green city' perspective. The term 'smart city' cannot be found too frequently in the documentation, but the focus is on using modern technology to support the environmental goals
With its energy and climate protection concept (2008), Frankfurt aims to reduce CO_2 emissions by more than 40 % by 2025. In 2011, Frankfurt set itself the target of converting the power supply to renewables by 2050. This climate roadmap is to be prepared with the support of scientific experts and public participation in the period from 2012 to 2014
Currently there is a public consultation underway on the 'Master plan 100 % Climate Protection'('Master plan 100'), which aims to turn Frankfurt into solely reliant on renewable energy until 2050 – a turnaround which implies a reduction of Frankfurt's energy consumption by 50 %
Frankfurt sees the following concept as potentially successful: 35 % of today's energy needs will be cut (energy-saving measures, greater efficiency); 20 % of today's energy needs will be met by renewables from within the city area; 45 % of today's energy needs will be met by renewables from within the region and beyond
In addition, the public real-estate developing agency will be extending its passive house strategy, with three aims
To develop the cost reduction potential in refurbishment and passive house construction for comparatively low rents and social acceptability
To further develop passive house technology in multistorey homes
Knowledge transfer of passive house expertise for other housing developers, building contractors, planners, architects and municipalities
In 2003, Frankfurt's city parliament voted to adopt a strategy aimed at increasing the share of bicycle traffic to 15 % by 2012 (1998, 6 %). Frankfurt's global transport plan (2005) includes a general strategy for integrated city and transport planning for the period up to 2015

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Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
The Digital Hub FrankfurtRheinMain has been founded to promote the digital infrastructure in the city and the region and to promote value-creating networks between providers and users. The association has set the following goals in particular	
To create a functioning network linking together industry, science and public institutions and to position Frankfurt am Main as the 'digital infrastructure' city in Europe and to promote research and development	
To raise public awareness regarding the importance of digital infrastructure and to achieve a lasting commitment from political and industry decision makers dealing with this issue	
To support the development of the innovative and market potential of the digital infrastructure FrankfurtRheinMain	
To boost the FrankfurtRheinMain digital infrastructure expansion	
DE-CIX, one of the most important Internet exchanges in the world, is based in Frankfurt, which today ranks second in Europe for data centre density. Internet exchanges with high electricity consumption and the associated CO_2 emissions present a challenge for green IT and hence have become part of the city's emission reduction strategy. The city authorities' IT components alone emit approximately 9,000 t of CO_2 per annum, at an annual cost of €2.4 million. 'Green IT' is intended to halve municipal IT electricity consumption and CO_2 emissions within 5 years	
The city plans to consolidate all server capacities in a new computer centre in the Department for Information and Communication Technology. Only highly efficient, high-temperature-resistant hardware components will be procured. As far as possible, natural cooling of network and server components will be utilised. Strictly user-dependent business management will be practised by activating all energy-saving options, scheduled client shutdown and switch-off of all peripherals. Shutdown of server capacities is no longer required owing to consolidation. In consequence thirty computer centres of various sizes can be closed	
IT infrastructure consumption values have been precisely recorded (14,200 MWh/a). Additional load profile meters should improve precision, enabling real-time monitoring of the results	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Traffic navigation:** a multimodal navigation system is being developed. Currently in its initial test phase, it will facilitate the combined use of bicycles, buses and trains, taxis, car sharing and the use of one's own car
Service 2	**Frankfurt e-mobility 2025 strategy:** a large number of individual projects will be promoting the use of electric cars and the requisite charging infrastructure, other electrically powered vehicles (e-bikes, pedelecs) and the interlinking of different transport means ('travel chains') by 2025. E-mobility has become part of the overall Frankfurt transport plan (2015–2025) By 2020, simple everyday usage of multimodal mobility chains with focus on e-mobility. By 2025 the plan is to have a wide and efficient network of public and private charging stations, to have achieved 10 % of automotive traffic to be electric, the share of low emission and low noise traffic in the city centre (inside the 'Anlagenring') to be 50 %, the electricity necessary for the EV to be produced completely from renewable energy sources and the 'Frankfurter Mode of Electro Mobility' to have become a national standard

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Service 3	**Solar map:** a 'Solarkataster' map is offered online from which residents can judge where there are suitable conditions for installing solar panels. The project is in cooperation with private companies, University of Frankfurt and Mainova AG as well as the Frankfurt Research Institute for Architecture, Civil Engineering and Geomatics http://www.gpm-kom8.de/geoapp/solarkataster/frankfurt/
Service 4	**CityGuide Digital Mapping System:** the CityGuide Digital Mapping System is an adaptable software system which can be configured to work in an unlimited number of federal, municipal and tourist-based application environments. CityGuide DMS is being used across Europe in more than 40 different cities to represent the official city map online at their respective homepages. The Frankfurt city map for 'climate protection' offers more than 1000 projects documented for climate and energy saving and renewable energy http://www.stadtplan.frankfurt.de/klimaschutz/html/de/index.html

Please describe the measures on organisation, policy, funding and business model of the smart city development

In 2004 the City of Frankfurt am Main was already working on 'environmental guidelines' for sustainable city development. The guidelines describe sustainable development as a task for all administrative and policy areas and one that requires all social and economic players to assume responsibility. In addition to the environmental guidelines, Frankfurt has adopted several systems and other guidelines for high-quality environmental management

The city's 'Guidelines for cost-efficient construction' (2005, revised annually) are among Europe's most demanding and detailed municipal building and procurement rules. New buildings must be constructed according to passive house standards and passive house components must be included in refurbishment work

In 1992 the city council adopted a policy of cooperating with banks and investment companies through its 'Energy Forum Banks and Offices' initiative. Since then, many projects for energy-efficient offices and low-energy high-rises have been completed. The city's 'High-Rise Framework Plan' (2008) requires new high-rise buildings to demonstrate primary energy needs of below 150 kWh/m²a, with at least 50 % coming from renewables. All new buildings and refurbishments in the city must comply with the 'Guidelines for cost-efficient construction'. Energy consumption values and costs for all municipal properties over the past few years and the quarter-hourly load profiles for more than 1,000 m are published online

Mainova AG plans to invest up to €500 million by 2015 in wind farms in Frankfurt, the region and supra-regionally, a stake in a highly efficient gas and steam power plant (combined cycled) and expanding district heating and constructing a biomass heat plant with CHP

Over the next 4 years, ABG will be investing an annual €250 million in new building and refurbishment

ÖKOPROFIT, a joint project of Frankfurt am Main and regional enterprises, demonstrates the compatibility of environmental responsibility and the pursuit of profit. The aims are to protect natural resources, to reduce emissions and waste and to cut operating costs by using energy and raw materials more efficiently. Since 2008, 32 Frankfurt-based companies have participated in ÖKOPROFIT, saving nearly €820,000 and 3,200 t of CO_2

5.2.7 *Issy-les-Moulineaux, France*

The general situation of the economic and social development of the city
 **Issy-les-Moulineaux** is a city of 65,000 inhabitants located in the suburbs of Paris. Relying on a very dynamic economic fabric, it is a leader on the employment front in the Paris Region thanks to its business district and its 350,000 square meters of offices. Issy-les-Moulineaux is one of the main centres of the French digital revolution. With 1,430 companies and 35,000 jobs in this sector, ICT is the economical driving force of the city, but Issy-les-Moulineaux also hosts important media groups, lending the city its nickname: 'Medialand'
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
In 1995, an ambitious digital technology strategy was adopted. It aims at promoting local development by modernising urban management through digital tools. That is why Issy-les-Moulineaux is one of the most connected French towns (90 % of the population) with the most innovative online services (from payment of parking fees through mobile phone to online registration on voter lists or management of children's registration in schools and recreational centres)
Since 2012, Issy-les-Moulineaux is the most important smart grid test territory in France. IssyGrid is managed by a consortium of a dozen companies. Its goal is to involve 10,000 employees and inhabitants of the town in the project in order to reduce buildings' energy consumption
In June 2013, the Digital Fort welcomed its first inhabitants in a brand new eco-district which combines sustainable development and new technologies (home automation, optic fibre, air-powered collection of waste, digital cultural centre 'Le Temps des Cerises', etc.)
In partnership with Greater Paris Seine West urban community (seven towns around Issy-les-Moulineaux gathering 310,000 inhabitants and 166,000 employees), the city will test several new smart mobility services aiming at facilitating inhabitants and employees commutation and reducing road traffic
Since the beginning, all municipal services were asked to think about potential utilisations of new technologies. These efforts were made within a steering committee to avoid scattering the initiatives. From infrastructures to reinforcing local democracy and from fighting the digital divide to modernising administration or developing mobile services, media and information technologies are turning Issy-les-Moulineaux into a successful example of a digital city
Since 2008, the European Network of Living Labs has labelled Issy-les-Moulineaux as the living lab for innovation. Issy has indeed developed a proactive policy to build a local information society which is innovative and open to all. The strategy adopted is to follow the developments of new technologies benefiting the population across the country. Issy is a cluster for innovation. By creating a collaborative environment bringing together the public, the private and the research sector, Issy has developed a 'reflex of innovation' studying and experimenting everything that could potentially contribute to improve the life of Issy's inhabitants or the development of the local economy
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

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The town is equipped with high-speed Internet infrastructures (ADSL, FTTH and optic fibre for companies). A geographical information system is managed at the urban community level. The town's information system is outsourced and currently managed by SPIE communication, using virtual servers (like some kind of private cloud)	
Plan: computer virtualisation (the idea is to get rid of hard drives at the user level and to go towards hard drive pool sharing). This started at the schools level, by placing application on a shared server and not on users' individual computers	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Digital Fort**: the eco-district of the twenty-first century and the concentration of services (home automation, optic fibre, air-powered collection of waste, straw-bale school, geothermal energy, feng shui swimming pool, digital cultural centre 'Le Temps des Cerises', etc.) was launched in 2013. It is possible to adapt these services to other towns. Target: citizens, companies and administration. Plans: ongoing urban development of the Fort district. Services are available for all inhabitants of the new Issy Fort eco-district
Service 2	**Open data:** the application **IssySpots** to find your way through the town was launched in 2012. It is possible to adapt this service to other towns, with service not provided alone on the cloud, closed API and utilisation strongly coupled with the Internet of Things. Target: citizens, companies and administration. Plans involve a real mobile practical guide; IssySpots offers a directory of numerous places of interest (transports, media and ICT companies, administrations; cultural, sports and educative facilities; parks; Wi-Fi access points). The number of places of interest is to be increased, and new services are offered in future versions
Service 3	**Education: digital technology as a development tool for education.** Téliss online service's portal enables the parents to manage their children's extra-scholar activities. The service was launched in 2008 (prepaid) and 2011 (post-paid). It is possible to adapt this service to other towns, with service not provided on the cloud, closed API and utilisation coupled with the Internet of Things. Target: citizens, inhabitants of Issy-les-Moulineaux and parents. The service benefited from several evolutions, and payment through smartphone is now considered. Actions undertaken to make this service available to everyone: accessible through www.issy.com (the town's website, communication tools used to promote the service like an explanatory video), working group consisting of elected parents
Service 4	**Les Flux d'Issy:** RSS flows which allow publishing automatically news, texts, videos and pictures about Issy-les-Moulineaux. Available freely on the AppStore and on PC, it allows the users to discover in real time the latest news in the city, via the articles published on the local website, the local web TV or the photo albums of the latest events. The application will soon be available for all platforms

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Service 5	**IssyGrid:** the first district-level smart grid. The initial equipment has been implemented: several office buildings, a hundred homes and part of the street lights in the Seine West district are now connected to the smart grid. The goal of this system is to enable the City of Issy-les-Moulineaux and the district's inhabitants to save significant amounts of money by pooling complementary needs and resources of offices, homes and businesses and by levelling energy consumption peaks. Operational since 2012, this information system covers the consumption of the entire district. Therefore, it enables the analysis of energy production and consumption in order to advice and encourages consumers, in partnership with the electricity distribution network, to consume at 'the right time' in order to reduce peak demands Ninety-four homes of the Seine West district have been equipped with smart meters. These meters, implemented by ERDF (French network distribution of electricity) in July 2013, gather live data on the global energy consumption of all concerned households. Around 20 of these 94 homes are equipped with a measurement and warning meter box, installed by Bouygues Telecom (Internet provider). Users will be able to compare their consumption data with those of similar households and get advice on how to consume in a smarter way An application for a tablet was designed to enable visitors to visualise in augmented reality the main applications of IssyGrid®. The goal is to allow experts, local authorities, companies and institutions to access on-the-ground data about the main operational features of IssyGrid®

Please describe the measures on organisation, policy, funding and business model of the smart city development
Issy-les-Moulineaux is labelled a 'living lab' at the European level. Therefore, inhabitants and companies are regularly associated to new service and application development through conferences and meetings, participatory workshops, polls and calls for testers
A digital agency 'So Digital' was created at the urban community level. It gathers representatives of the urban community, towns and Ile-de-France Region, of the competitiveness centre Cap Digital, of companies, of research labs and of universities located within the urban community territory
The population is informed every month of the new digital projects and offered to voice its opinion through a 'citizen task group' consisting of 900 inhabitants representing the population. Inhabitants and companies are also involved through events like the regional festival of digital innovation, 'Futur en Seine' held in June 2013. A *serious game*, a sort of treasure hunt, was specially developed to inform a wide audience about the numerous digital services the town offers
Project management varies according to situations and actors: IssyGrid, for example, is managed by a consortium of private companies, with the support of the town. Other projects are managed directly by the town or by Issy Média, a joint public-private company in charge of Issy-les-Moulineaux's communication and innovations. Local authorities rely more and more on versatile organisations like public-private companies, local public companies or public interest groups. These organisations are more flexible in their operation
Funding varies according to projects: private as for IssyGrid; municipal for the management of population sensitisation activities; public, in the scope of project financed by the region; and the state or the European Union, as for Radical, Citadel on the Move or Smart City+
Since 1999, the population of the town increased by 35 %, while the number of civil servants stayed the same (thanks mainly to improvements in productivity through outsourcing of our information systems), local taxes have been reduced by 20 %, and unemployment level is of 6 % to be compared to the national average of 12 %

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5.2.8 *Lyon, France*

The general situation of the economic and social development of the city
 The population of **Lyon** is 484,344 (2010). Together with its suburbs and satellite towns, Lyon forms the largest conurbation in France outside Paris. Its urban region represents half of the Rhône-Alpes region population with 2.9 million inhabitants. Lyon is a major centre for banking as well as for chemical, pharmaceutical and biotech industries. The city contains a significant software industry with a particular focus on video games and in recent years has fostered a growing local start-up sector. Lyon is ranked 2nd in France as an economic centre and convention centre. Lyon was ranked 8th globally and 2nd in France for innovation in 2011
The GDP of Lyon is 62 billion euro and the city is the second richest city after Paris. According to the ECER-Banque Populaire, Lyon is the 14th favourite city in the European Union concerning the creation of companies and investments
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
Greater Lyon is reaching out to combine economic dynamism with sustainable development and wants to become a test-bed area for the design and development of innovative services and usages. Greater Lyon needs to build new developmental models for the area
Under the definition in 2011–2012, Greater Lyon's smart city strategy has been officially launched in 2013, and such outcomes/impacts are being evaluated and the results will be available at the beginning of 2014. Greater Lyon recently launched its innovation strategy as well as a digital policy with the following objectives
Turn Greater Lyon into a territory of innovation through creativity and digital technology
Support the development of infrastructures, the basis for all digital projects across the urban area
Reinforce coordination between all players involved to ensure a common goal and high visibility, in order to develop a digital identity that enhances the attractiveness of the Lyon urban area
Encourage the emergence of new uses, enabling Greater Lyon residents to enjoy a higher quality of city life together and offer innovative, optimised urban services so that resources and flows within the urban area can be managed more effectively
Encourage the development of innovative projects with a digital aspect by promoting experimentation and supporting current initiatives
Incorporate digital technologies and associated innovations in all major urban projects and public policies within the Lyon urban area
At an economic level:
Encourage business creation and support the emergence of the jobs of the future in the digital economy and in the green economy
Attract investment in the area of the city of tomorrow, within the context of strong competition from other cities
At sustainability level:
Promote changes in energy use (production/distribution/consumption)
Offer new transport solutions in areas that have more and more constraining factors
With respect to the environment and energy:
The project plans a yearly savings of 200 000 t of CO_2 by 2020 for the Lyon urban area
Private and professional users will spend less time on transportation through information technology and the optimisation of network use

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With respect to economic development	
Using synergy developed within the project, partner companies can provide high-level commercial offers on an international scale, which can be extended to other European cities. At an urban development level: finding new ways of thinking about the way the area is managed	
Emphasis on Research and Development:	
The City of Lyon actively encourages technological, organisational and social innovation in business	
Lyon has a proven track record as a European city of innovation, as demonstrated by the number of patent applications, intercompany collaborations and teaching and research centres, as well as by its total expenditure on research and development	
The city also boasts 126,000 students, 10,000 researchers and 500 public and private laboratories	
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city	
Greater Lyon has defined its broadband strategy 2012–2019 and is engaged to provide fibre-optic broadband access to both residents and professionals between 2015 and 2019. One data centre of 3,800 m^2 and several new smaller (500–1,000 m^2) 'commercial' data centres have been created by local players; a strategic plan to establish new data centres for middle-sized enterprises has been developed	
Greater Lyon has deployed a data platform fully open source named SmartData that can deliver GIS data (static or real time) using OGC standards. Greater Lyon is currently studying (2014) how services will be delivered for external utilities, roadwork operators, construction permissions, civil security information, etc.	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Changing energy use and smart grids:** On the theme of energy transfer and smart grids, the Lyon region is home to several experimenters and demonstrators: Lyon Smart Community (with the NEDO), Greenlys, Smart Electric Lyon, Watt & Moi, Linky experimental deployment and the European Transform project in partnership with Amsterdam, Copenhagen, Vienna, Genoa, Hamburg, etc.
Service 2	**Optimod'Lyon:** Greater Lyon has brought together twelve partners to carry out the Optimod'Lyon (project budget of 6.93 million euros) on 'optimising **sustainable mobility** in the city'. To reach the goal of improving travel for people and the traffic of goods, the strategy supported by Greater Lyon and its partners includes three key elements: an integrated approach to personal transportation and urban freight, with, in particular, optimised management of public areas; the development of services based on ITS and supported by large transportation infrastructures in the Lyon urban area and a considerable amount of reliable data available in real time, which is rather unique in France, and the development of an innovation policy in partnership with the private sector, giving companies the possibility to develop new services for private individuals and professionals
Service 3	**Remote and contactless services:** Remote and contactless services are used very regularly for payments, travel information, cultural and tourist information, remote public services, etc.

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Service 4	**Greater Lyon SmartData:** To provide public access, to both private individuals and professionals, to a portion of its reference and management data (but also those of its partners), Greater Lyon created a data and services dissemination platform called Greater Lyon SmartData The primary objective is to support innovation and new uses. To that end, Greater Lyon SmartData considers the data to be a key catalyst for the local economy and a vector for growth and innovation. Various specialised systems mean Greater Lyon can support its partners (municipalities, businesses, the academic world) by encouraging generation of added-value services for users and enhancing or optimising current offers. A second objective is encouraging citizen participation by giving citizens greater opportunities to interact with public authorities Entirely based on open sources, one can research, uncover and visualise the available **geographical data**. Three levels of licence exist in order for Greater Lyon to ensure good quality services and control competitiveness among users
Service 5	**Lyon Smart Community:** The objective of Lyon Smart Community is to transform La Confluence district into the gold standard of neighbourhood energy efficiency. It is a unique large-scale demonstrator that encompasses several dimensions, including a complex of positive-energy buildings; a fleet of electric vehicles powered by solar-powered stations; smart meters (electricity, gas and water) in social housings to measure, analyse, display and monitor consumptions; and a community management system to manage (collect, process and restore) experiment data. This PPP involves 30 partners and is an example of international collaboration

Please describe the measures on organisation, policy, funding and business model of the smart city development

The smart city strategy has been defined by the Lyon urban community (Greater Lyon). It is cocreated through projects with other stakeholders, especially the industry, academia and citizens. Greater Lyon's smart city strategy is led by the Economic and International Development Delegation but has been defined in a transversal manner with the involvement of all the departments (mobility, energy, urbanism, water, wastes, sanitation, information systems, law, communication, etc.). A technical committee representing all these departments meets regularly in order to coordinate their activities related to smart city, co-define the strategy and common dialogue and take major decisions. Greater Lyon (the urban community) is also working closely with each of its 58 municipalities as well as other administrative divisions such as the Rhône-Alpes region and will soon merge with the Department of Rhône to create the Metropolis which will allow including new sectors such as health, education and social services into a more integrated smart city strategy

Funding mainly comes from the companies involved in each projects as well as specific grants (municipal, regional, national, international) or foreign investors. Greater Lyon is not destined to finance all smart city projects; therefore, the major part comes from private sources (about 97 % in 2013), mainly through PPPs involving the government, academia and industry

Two Greater Lyon standards for environmental quality in construction have been drawn up by the Greater Lyon Local Energy Agency (ALE) with the support of the ADEME (Environmental and Energy Agency): 'Habitat durable' (2004, 2006 and 2009, updated 2012) and 'Bureaux durables neufs' (2006 and 2012). These standards are systematically used when Greater Lyon consults on industrial parks and local authority land as well as when social housing is proposed. They lay down environmental performance requirements which new construction projects need to satisfy and absorb. Following Habitat durable coming into force in Greater Lyon, by December 2012 there were already 11,063 homes that were in programming, design, site work or delivery stages. Following Bureaux durables neufs coming into force in Greater Lyon, by December 2012 there were already 284,546 m^2 of office space whose energy went beyond the heat regulations that were in force during the time they were built

5.2.9 *Malmö, Sweden*

The general situation of the economic and social development of the city

Malmö is Sweden's third largest city by population. It is the capital of Skåne County. Together with Copenhagen, it constitutes the transnational Öresund Region. Since the construction of the Öresund bridge, Malmö has undergone a major transformation, attracting new biotech and IT companies and students through Malmö University. The city contains many historic buildings and parks and is also a commercial centre for the western part of Scania. Malmö was ranked #4 in Grist Magazine's '15 Green Cities' list in 2007. The administrative entity for most of the city is Malmö Municipality which, as of March 31, 2013, had 309,105 inhabitants in eight different localities. The region covers an area of 2,522 km^2. Malmö has more than 400 km of bike paths and approximately 40 % of all commuting is done by bicycle

Around seven new companies are started every day. In 2010, the renewal of the number of companies amounted to 13.9 %, which exceeds both Stockholm and Gothenburg. Among the industries that continue to increase their share of companies in Malmö are transport, financial and business services, entertainment, leisure and construction

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

Malmö joined the Covenant of Mayors to reduce emissions and will go beyond the EU's energy target, bring forwards a sustainable energy action plan, arrange energy days, participate in the mayors' conference and disseminate information. Malmö's Environment Programme (2009–2020) and the Renewed Energy Strategy 2009 are key documents steering current and future actions, as well as ensuring related budget feasibility to adopt short- and long-term measures. Malmö's 2010 budget ('sustainable future') an ecologically sound sustainable city and thus the reduction of emissions in various sectors as significant goals

The environmental programme will provide the basis for future comprehensive plans within ecological sustainability and is therefore not a sector programme in the traditional sense. The Environmental Objectives Portal and the authorities responsible for environmental objectives have followed up and evaluated the national quality goals and have emphasised that the proposed environmental quality objectives should be reached by 2020. By then, the City of Malmö will be climate neutral and by 2030 the whole municipality will run on 100 % renewable energy. Energy consumption will decrease by at least 20 % per person by 2020 and by a further 20 % by 2030. Solar, wind, water and biogas will be phased in and fossil fuels phased out. The ambition is for as large a proportion of the required energy as possible to be produced locally. Greenhouse gas emissions will decrease by at least 40 %, calculated from 1990. Malmö will prepare for temperature changes, rising sea levels and increased precipitation

All departments and city-owned companies have internal environmental management initiatives and an environmental coordinator to monitor their efforts. Several are certified in accordance with EMAS or ISO 14001. Every year an environmental report is produced, which monitors the city and specific departments' (and the municipal companies') progress towards the goals included in Malmö's Environment Programme

Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

In broadband the city invests about 45 million kroner per year, and together with the private players, about 72 % of Malmö's households receive fibre connection today. Expansion will take place gradually. The executive committee has decided that 95 % of households will be able to obtain access to this infrastructure by 2020. The City of Malmö has itself commissioned two central data centres as well as reviewing 'cloud' management. The city is also considering moving towards hybrid cloud platforms

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The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Hack your energy:** a set of Arduino modified energy meters that display results on an open data Internet portal. The residents at the housing cooperative use this service to better understand their energy consumption. As understanding increases, they use social media to share tips and tricks for more sustainable living. The methodology drew the interest of the municipality and is gradually being picked up in their organisational way of working. An initiative has also been started to set up a regional living lab based on participation from citizens and run by the city and regional business clusters, with a life of its own
Service 2	**Green public procurement**: all new vehicles purchased by the City of Malmö represent some of the best environmental models available. As the city replaces older vehicles, it aims to build a fleet comprised of 100 % clean vehicles (of which 75 % biogas/hydrogen/plug-in hybrid/electric in 2015). Among Malmö's green-car fleet is Sweden's first hydrogen car, running on stored wind energy, driven by employees of Malmö's Environment Department. Malmö and the energy provider, E.ON, are working to advance biogas made from food waste, incorporated as a transport fuel. Today, some 50 % of Malmö city buses run on a mixture of biogas. Sjölunda Waste and Sewage Treatment Plant was renovated in 2008 to produce biogas from collected waste and then upgraded at E.ON's upgrading facility
Service 3	**Malmö Initiative/Malmö Panel:** two examples of how the residents of the city can participate and influence the content of the municipal decision-making. Via the Malmö Initiative, citizens can make suggestions and comments pertaining to various areas via the Internet. One can take up a debate and get support from others involving various issues. The Malmö Panel is a forum for the 1,600 Malmö residents that, twice each year, have a say on issues brought up by Malmö's councils. The Malmö City Planning Office has also adopted a process to facilitate research and public discussion – the **Dialogue PM process** – concerning key challenges affecting land-use patterns. As a result, various vision documents are created, acting as precursors to formally adopted or politically sanctioned programmes
Service 4	**BuildSmart:** the district of Hyllie will become a testing ground for the smart city of the future. Five constructors involved in Hyllie have received SEK 50 million in grants from the EU for a project in which climate-smart solutions for ventilation, cooling and heating are to be tested. One of the visions in this is for the technology to visualise to the user how he himself can influence and route the energy consumption
Service 5	**Local climate contracts:** the city, E.ON and the municipal authority VA SYD in 2011 signed a climate contract in which they committed to turning the district Hyllie into the most climate-smart city district in the region and that its energy supply, at the latest in 2020, will consist entirely of renewable or recycled energy, for example, distribution of various tenure forms of apartments, where open common areas are to be placed or how sewage and energy systems are to be designed. Together with the municipality the constructors of the residential area along Hyllie Allé (1,700 apartments) have signed a so-called sustainability agreement

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Please describe the measures on organisation, policy, funding and business model of the smart city development
The City of Malmö has 12 central administrations. At least half of these have incorporated some type of environmentally managed systems, two of which are certified. Additionally, Malmö is divided into 10 districts, each with their own city-district administrations; eight of these have incorporated a type of environmental management system. Malmö also has four municipal companies (refuse maintenance, the Malmö Port, parking and parking garages and a housing authority). Two of these municipal companies are certified with ISO 14001. Consequently, nearly all municipal departments and municipal companies have incorporated some type of environmental management and reporting mechanism, and every department has at least one person (the environmental coordinator) specifically tasked to work with the respective department's environmental issues. Of Malmö's respective departments and municipal companies, 20 % have been certified by ISO 14001 or EMAS. Every committee and steering board bears responsibility for achieving the objectives set out for their particular sector. Committees and steering boards will break down the general objectives into manageable targets and measures appropriate for each area of responsibility and incorporate these targets and measures into their agenda. To ensure that the work that is carried out achieves the general environmental objectives, the development will be monitored by quantitative and qualitative indicators set by the committees. The Environment Committee will coordinate this work and set the indicators for the whole municipality
Residents of the city can participate and influence the content of the municipal decision-making through the Malmö Initiative and Malmö Panel. Malmö Initiative allows citizens to make suggestions and comments pertaining to various areas; Malmö Panel is a forum for the 1,600 Malmö residents that, twice each year, have a say on issues brought up by Malmö's councils
Several of the city's initiatives are financed by the EU CIVITAS programme. SMILE project (clean and better transport in cities), together with four other European cities: Potenza (Italy), Suceava (Romania), Norwich (UK) and Tallinn (Estonia). Over 50 subprojects were carried, to address an improved traffic environment, including reduced emissions and less noise. This project represents the largest EU project led by Malmö to date, with an overall budget of over SEK 300 million (roughly 30 million euros). Malmö constantly monitors the wide range of EU funding programmes to ascertain what projects might help cities become smarter and more sustainable and what financial, social, economic and environmental returns on investment might be possible and how may strategic investment vehicles like JESSICA Urban Development Funds provide targeted support.
Currently smart city-related budget items are included in the normal budgetary process
The City of Malmö is working together with WWF and SEI (Stockholm Environment Institute) to gain a holistic understanding of Malmö's total emissions through the design of the **REAP (Resources and Energy Analysis Programme) tool**. It provides the opportunity to highlight the global footprint of housing, food, transport and related consumption concerning emissions and other impacts, by creating a common measuring system, as well as various scenarios to compare how possible actions to reduce the footprints can actually make a difference. Designed by SEI, REAP aims to help municipalities, government agencies and other organisations identify their (or their citizens') ecological footprint as well as, in particular, their carbon footprint. It also helps identify and support policy development to reduce these footprints

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5.2.10 Manchester, UK

The general situation of the economic and social development of the city

The City of **Manchester** is located at the core of the Greater Manchester metropolitan area. Greater Manchester is the single biggest economic area outside London and the southeast with a GVA of £47 billion and residential population of 2.7 million. Greater Manchester is made up of ten local authorities, of which the City of Manchester is the largest both in terms of population and GVA. It has a population of 510,800 which has grown by 19.0 % between 2001 and 2011 – almost three times greater than the national average. Manchester's GVA is £13 billion per annum contributing 28 % towards the wider Greater Manchester economy

Manchester's core sectors are the business, finance and professional service sector which contributes 38 % (£5 billion) to the city's economy. It has a strong offer in terms of the design, consultancy and engineering services required for the development of smart cities, with the most leading global technical consultancies having regional headquarters located in the city along with a significant global engineering presence, including Siemens. Other strengths in this field include digital and advanced manufacturing which contribute £587 million and £445 million, respectively

Manchester has the highest student population of any European city and has more active Nobel Prize winners than Cambridge and Oxford Universities combined. This includes that around Graphene for which a world leading research institute is being constructed. The city has over 1.7 international leisure visitors each year and has the 3rd busiest airport in the UK

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

The city is currently developing a new smart city vision and strategy. The vision will be completed in December and the associated strategy and roadmap in early 2014

The draft smart city vision for Manchester[7]:

> By 2025 Manchester will be amongst the top 20 smart cities in the world. In achieving this goal we will have harnessed our industry and instinct for innovation to drive growth and reduce dependency. At the heart of this evolution will be the harnessing of data to accelerate the establishment of a knowledge rich and intelligent city that drives agility, confidence and entrepreneurialism

In achieving this we will:

> Equip our businesses to have the ambition and confidence to innovate, progress and flourish and in doing so capture a competitive share of the market place

> Establish a showcase smart city with resilience and carbon efficiency at its heart

> Empower all our citizens to have access to opportunity to fulfil their potential whilst protecting the most vulnerable

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Underpinned by its transport, planning, climate change, digital and community strategies in the medium term Manchester aims to:
Develop a world class innovation eco-system, linking people, business and place building on our work around advanced materials and ehealth
Establish an open data platform that will help it to; plan and predict future investment around infrastructure; manage the operational side of the city in real time; and provide opportunities for growth
Further develop the digital infrastructure to help tackle issues around dependency improving the social mobility of some of our most deprived communities
Establish a series of 'smart infrastructure zones' where the city will pilot interventions around innovative energy and transport infrastructure investments at scale
The overall impact of the Future Cities Manchester programme will be to demonstrate how a city can achieve sustainable economic growth and create a more attractive place to live while reducing environmental impact. The key areas in which Manchester will measure impacts and progress towards targets will be across the following:
Creating markets for new technology products and applications
Providing opportunities for demonstration and market-testing
Improving the efficiency of doing business, for example through tackling congestion, improving mobility, and making deliveries more efficient
Increasing access to health services in the home; reducing the cost of keeping homes comfortably heated
Increasing mobility, particularly the opportunity to walk and cycle safely
Engaging people more in how their city is managed, fostering an increased sense of community and participation
Increasing low and zero carbon energy supply
Cutting road transport emissions through modal shift
Reducing energy demand and improving the efficiency of supply
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Manchester was one of the first cities on Microsoft's CityNext initiative to digitise public services using the cloud
Free Wi-Fi is available in many city centre locations as a result of a deal between Manchester City Council and Arqiva (a communications infrastructure and media service company)[8]
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

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Service 1	**Transport:** Dynamic Road Network Efficiency and Travel Information System (DRNETIS): Manchester has been extremely successful in securing investment around its transport proposals, of which a significant component is the deployment of smart transport services. At the heart of this service is DRNETIS, which is critical to the delivery of the city's Smarter Travel package and is being delivered under the LSTF programme The DRNETIS solution will allow the city to build a set of interventions that can be implemented much more quickly than at present when certain situations occur. These interventions may be actively changing the operation of the network, for example, by changing the traffic signal sequences or by influencing travellers through providing them with information on their planned journey and providing other alternatives. These interventions will be deployed either automatically without user intervention or by giving an alert to a user who can make a decision about whether to implement it. In addition, the city is seeking to provide a more holistic approach to delivery of information across all modes DRNETIS will enable the delivery of real-time information to travellers enabling them to make smarter choices with a greater degree of confidence on the reliability of services. The ability to receive personalised alerts and information will also be a significant benefit that the DRNETIS solution will deliver The DRNETIS solution will also provide a substantial amount of data that the city will want to be able to analyse and use tactically and strategically to make better decisions about how we plan and manage the network
Service 2	**mHealth/eHealth:** the University of Manchester is a centre of excellence for multidisciplinary mHealth and eHealth research and for engagement with the health and social care sector *mHealth* The mHealth Innovation Centre (mHIC) aims to exploit the rapid evolution of mobile, wireless technology. Major focus areas include: Mobile support for mental health: experience sampling for recording medications, symptoms and mood in real time and with personalised feedback and delivering therapy for depression, schizophrenia, OCD and suicide prevention Using social networking to feedback information to formal and informal support networks Evaluating patient self-management of long-term conditions through near-patient and wearable monitoring telemedicine, telecare and use of smartphone apps Falls monitoring and prevention using biofeedback via GSM-connected devices *eHealth* Manchester's Health eResearch Centre is a world-leading multidisciplinary e-research environment using advanced methodologies to unlock and harness real-world evidence from health data across Northern England. HeRC's e-Labs undertake advanced processing of health records, integration of data and reuse of data in a secure environment for analysis of de-identified, continuously linked records *Manchester mHealth Ecosystem* Manchester leads the Manchester mHealth Ecosystem, the first in an international network of such ecosystems across Europe. This is a long-term partnership established to accelerate the adoption of mHealth technologies in health and social care in Greater Manchester. Members include NHS healthcare providers and commissioners (acute, primary, community, specialist), local authority social care providers and commissioners, industry (technology, digital, healthcare, pharma), academia (Universities of Manchester and Salford) and voluntary sector and patient groups

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Service 3	**Service reform:** public services in Manchester are deploying ICT investment to reform and improve services. The vision for growth and reform is to ensure all people in the city are contributing to, and benefiting from, growth in the economy. Within this vision, no one is left behind There is a significant investment in families that have complex issues. For the first time, data from different agencies and sources were brought together in order to develop a family plan that will address the root causes of criminality, worklessness, underperformance at school, antisocial behaviour, debt, etc. This integration is proving to be more effective and cost effective than working with individuals on single issues and is enabled by the city's investment in iBase – an IBM (i2) product that connects data and visualises it so that key workers can see the full extent of the family and its issues The data warehouse that sits behind the system has enabled strategic analysis of big data to better understand the connection between people and place and the epidemiology of 'troubled families' – how changes to the benefit system have affected supply and demand of cheap housing, where complex families migrate to and what services are available in the neighbourhood to help them. Using GIS, we are connecting data about people to plans to develop places and services in order to maximise the investment Health and social care agencies and services for families with young children are utilising technology to help people benefit from services in the community. These include alarms and communication devices that support people with advice and targeted help when and where it is needed
Please describe the measures on organisation, policy, funding and business model of the smart city development	
Manchester provides a distinctive opportunity through its investment approach to leverage funding from the public and private sectors and develop links with other programmes	
Greater Manchester Combined Authority has an investment framework which draws together funding from the public and private sector to deliver a pipeline of projects that supports its strategic priorities. This includes European ERDF and the post-2013 programme, regional growth funding, the Greater Manchester Transport fund, the GM pension fund and other private sector investments	
To support the development and subsequent delivery of a robust pipeline of smart city projects, Greater Manchester engages with business through existing formal structures and through developing individual market-facing projects. The strength of the relationship between the city and business is a real asset for Greater Manchester and is evidenced through its track record of delivery. Examples of where this approach has been adopted to support project delivery include the expansion of the broadband network, the Manchester Airport Enterprise Zone, the Business Growth Hub, Manchester Science Parks and the Green Deal	
A city the size and scale of Manchester presents significant opportunities for developing links between other programmes and investments. Manchester has a strong base to capitalise on this opportunity and leverage additional public and private funding through its investment approach	
In terms of governance the Manchester Corridor Partnership provides a ready-made structure for delivering the city's smart city programme. Established in July 2007 as an incorporated body, Corridor Manchester recognised at its inception the importance of bringing world-class organisations together to work in partnership. The city council will have overall responsibility for successful delivery of the programme which will be managed through the Corridor Partnership	

[7] Source: 'Smart Cities: Manchester City Council – Report for Resolution', December 2013 www.manchester.gov.uk/download/meetings/id/16126/6_smart_cities.

[8] Source: http://www.manchester.gov.uk/info/200109/council_news/5922/manchester_people-january_2013/6.

5.2.11 Riga, Latvia

The general situation of the economic and social development of the city

Riga is the capital and largest city of Latvia. With ca. 700 000 inhabitants, Riga is the largest city of the Baltic States and home to more than one-third of Latvia's population. Riga's historical centre is a UNESCO World Heritage Site. The city is the European Capital of Culture during 2014, along with Umeå in Sweden. Riga is one of the key economic and financial centres of the Baltic States. Roughly half of all the jobs in Latvia are in Riga and the city generates more than 50 % of Latvia's GDP as well as around half of Latvia's exports. Riga Port handled a record of 34 million tons of cargo in 2011 and has potential for future growth with new port developments on Krievu Sala. Tourism is also a large industry in Riga and after a slowdown during the recent global economic recessions grew 22 % in 2011 alone. Riga is a member of EUROCITIES, the Union of the Baltic Cities (UBC) and the Union of Capitals of the European Union (UCEU)

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

The 'Riga City Long-Term Development Strategy 2025' sets out the city's aims at achieving modern environmental governance and actions to bring improved air and water quality, enhance waste management practices, reduce or eliminate pollution and their causes, improve energy efficiency and maintain the biodiversity. Riga's smart city strategy is in particular formulated through the Riga City Sustainable Energy Action Plan for 2010–2020 (with two monitoring reports since), as well as the Riga Smart City Sustainable Energy Action Plan 2014–2020. Riga's vision involves three themes: (1) Planning and Management: design and execute a city plan to realise full potential for citizens and business while efficiently running daily operations. (2) Infrastructure: deliver efficient fundamental city services that make a city liveable for citizens. (3) Human: provide effective services that support the economic, social and health needs of citizens

Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

For the smart card services, a centralised information network that manages all data within the system has been developed. This has been built to manage the complex nature of the system and its many different functions, whether it is used in order to access social services, public transport or parking. The multifunctionality of the network also means that it can be accessed from different geographical locations and through different types of technologies, depending on where and for what you are using it. This also means that the network consists of many different 'nodes', such as ticket validators where passengers validate their cards, consoles that the drivers use for validating and selling tickets, the portable terminals that are used by the staff in order to check the passenger's tickets as well as the data concentrator which connects the system with the main data centre

The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

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Service 1	**Lighting:** the project RPA 'Rīgas gaisma' aims at improvement of energy efficiency in city lighting. Riga has embarked upon a policy of replacing old, sodium lighting fixtures on its streets with 1,154 new LED units. An additional scope for reduction of energy consumption is realised by including the installation of voltage regulation systems on each unit. The units have a transmission system that allows each lamp to be controlled remotely and according to the required level of lighting. Voltage can be reduced in order to respond to the level of daylight and provide the relevant level of lighting. Each lighting column houses the voltage regulators, which enables each street light to be controlled separately. The electricity consumption data of each light are also collated separately. Communication of remote controls is transmitted over a set radio frequency. The programme cost approx. €1.8 m and was partially funded by the Riga municipality. Implementation of this programme achieved a reduction of 400,000 kWh and reduced CO2 emissions by 150 t per annum
Service 2	**E-talons/smart card:** Riga has created a simpler and modern transport payment system by introducing smart tickets called 'e-talons' that are accepted on all modes of transport in the city. The project started in 2007, with the aim of creating an electronic payment system for public transport in Riga and to ensure its functionality. The tangible results are manifested in faster, simpler and more reliable passenger traffic records for the municipality, providing better data for transport policy appraisal. This informs Riga's city planners when attempting to optimise urban traffic flows and implement effective traffic management. Furthermore, 56 % of public transport is electric with wireless Internet available on some routes The e-tickets are easy to use, compatible with other functions within the city and have estimated to have provided a cost saving of 25 % approx. Riga has also reported increased passenger satisfaction with the city's transport services It is a multifunctional system that can be used as payment for public transport, to register for different social services (e.g. catering services) and for city car parking, park and ride or access to different kinds of discounts for certain social groups. Students use the same e-talon card to register their arrival at school as they did to travel there, and persons who qualify can use the card to register for free food parcels
Service 3	**Heating apartment buildings:** transferring from a one- to two-pipe system that allows for better heat consumption regulation and more accurate metering. The new energy management system included the installation of an automatic load-balancing system that regulates temperature control in apartment buildings. Bypasses and thermoregulators on radiators were installed along with radiator meters that can be read remotely In the apartments that have been fitted, each radiator thermostat is set to a desired room temperature. Regulation of temperature through the upgraded system reduces consumption of heat and reduces bills for consumers. By lowering the temperature by 1 °C, consumption was found to fall by 5–6 %, which helps reduce the city's CO_2 emissions The heat consumption management system allows for effective setting of lower temperatures in apartments during daytime hours and at weekends when residents are often outside of their homes. The return heat temperature controls an automatic load-balancing system that maintains comfortable temperatures in apartments which increases consumer satisfaction with the heating system

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Service 4	**Torņakalns complex:** the initiative derives from wider plans to develop a new city centre – the Pārdaugava centre. It is also a result of long-term discussions on the concept and location of a new administrative centre for the city, which will now be established as part of the new complex The complex will consist of a combination of buildings, transport infrastructure and public spaces. As an integrated project, it will feature different functions, including Riga's Administrative Centre, Academic Centre for the University of Latvia, housing, schools, workplaces, recreational and shopping areas and transport services The Torņakalns project is designed to help meet the city's overall strategic 2030 goal: to create energy efficient, resident-friendly and modern neighbourhoods with reduced traffic flow in the city centre and neighbourhoods situated close to the centre being used more intensively. Energy for heating, ventilation and cooling will be supplied by a district heating system. Ground heat will be integrated into heating and cooling systems, with bearing poles functioning as thermo-probes for the heat pumps. Air conditioning equipment is planned to include heat and humidity retrieval. Lighting will be provided by luminescent lamps, energy-efficient lamps and LED diodes. Furthermore, outdoor lighting will be powered using renewable energy resources such as wind rotors and solar batteries, with reserve connections to the grid
Service 5	**Transport:** electric transport in Riga has been increased to 56 %. There are 19 trolleybus lines with 250 cars and 9 tram lines with 207 cars. Public transport is free for pupils, disabled and retirees. Free Wi-Fi is available in the public transport and at the stops

Please describe the measures on organisation, policy, funding and business model of the smart city development
The Riga smart city policy is governed by the management board, which is headed by Riga City Council and includes representatives of citizens NGOs, researchers, energy companies and service companies; the Riga Sustainable Energy Action Plan (SEAP) advisory board, which comprises leading scientists and experts in the energy and housing sectors, and the coordination group comprising city departments and city-owned companies
As a large-scale example, the Torņakalns project has been planned as a long-term approach, with the historical roots of the initiative starting when the concept and location of a new administrative centre for the City of Riga was discussed over 10 years ago. Collaboration and dialogue with all stakeholders have been established through a management and marketing committee (established in 2008) with 22 members from stakeholder organisations. Each organisation represented a particular area, and the committee enabled stakeholders to harmonise projects and decisions, create ideas and find solutions. Citizens have also been engaged through an exhibition of the projects for all Riga residents and a 4-week public consultation. The first stage of the initiative, which focuses on the establishment of the university buildings and their equipment, is partly financed by the European Regional Development Fund and partly by Latvian governmental organisations
A research study on the technical and economic justifications for the redevelopment of brownfield sites in the Torņakalns district was conducted in 2009, forecasting a number of benefits from the development. These include productivity growth and improvement in educational quality, cost-saving benefits expected from the relocation and merging of the university and additional employment. Furthermore, the project is expected to contribute to reduced environmental pollution in the area. The expected energy savings from the project are 50–70 % compared to areas of a similar scale that are built in a traditional way

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Riga is a part of the Step-Up partnership, which seeks to develop the following: integrated approach to energy planning, promotion of integrated cross-sector energy solutions, identification of lighthouse projects, building of existing projects to ensure deployment in the 2013–2020 timeframe, integration of planning to achieve better energy outcomes and economics and replication in other cities. Key outputs will be enhanced SEAPs in all partner cities, innovative integrated energy projects, a model for delivering integrated SEAPs, a learning network of cities, training programmes for professionals and a new master's course on sustainable city planning and implementation

5.2.12 Tallinn, Estonia

The general situation of the economic and social development of the city

Tallinn is the capital and largest city of Estonia. It occupies an area of 159.2 km^2 and has a population of 430,594. Tallinn's Old Town is listed as a UNESCO World Heritage Site. Tallinn is the financial and business capital of Estonia. Over half of the Estonian GDP is created there. In 2008, the GDP per capita of Tallinn stood at 172 % of the Estonian average. The city benefits from the high level of economic freedom and liberal economic policy and has a highly diversified economy with particular strengths in information technology, tourism and logistics. This puts the GDP of Tallinn at 115 % of the European Union average, while the overall GDP level of Estonia is 67 % of the EU average

Tallinn has been listed among the top ten digital cities in the world and was ranked as one of the world's seven smartest cities by the by 'Daily Mail'

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

Tallinn's smart city vision derives from its Development Plan 2014–2020, the city's primary development document, adopted by the city council in 2013. The vision formulates the goal of 'effective city agencies that have knowledge-based management and a good service culture'. It also provides narrower objectives for various fields in city development and various smart city activities. This development document encompasses all fields of city development, including goals and activities in the field of ICT. It also contains activities and projects for the implementation of smart city solutions and new technologies in various fields, like city transport, social care, etc.

Another milestone of Tallinn as a smart city is the Enterprise and Innovation Strategy 2014–2018. The goal of the strategy is to create better conditions for enterprise development and innovation in Tallinn and thereby improve Tallinn's competitiveness. These goals are supported by the strategy's 5-year action plan, which includes actions like support for cluster projects and inter-sectorial cooperation, smart immigration, creation of innovation centres and new innovative products and services and the overall development of the smart city concept

The city has adopted a Green Capital Action Plan, one of the aims of which is to achieve the title of 'European Green Capital Movement', which is awarded for cities that have markedly improved the living environment and implemented the principles of sustainable development. Part of the implementation of this plan is done through suitable use of modern ICT, such as in managing excavation permits

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In 2009, Tallinn signed the Covenant of Mayors, an EU programme for local authorities in the field of sustainable energy policy and in 2011 adopted a sustainable energy action plan, with the goal of reducing CO2 emissions
On a national level, the Estonian government approved the Information Society Development Plan 2013+ in May 2012. The main priorities of the plan are (a) next-generation broadband network, (b) development of e-business environment, (c) digitalising public services, (d) e-ID and (e) knowledge and skills development
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
The development of Estonia's Internet society was guided by the Estonian Information Society Strategy 2013. One of the general principles of developing e-services in Tallinn is the maximum use of existing ICT infrastructure on state level. Services delivery input is enabled by state infrastructure and state portal and ID card. Data sources on state level for Tallinn e-services are population registry, education information system and pension insurance registry
Tallinn City Government back-office information systems Sports Support Information System and Subsidy Independent from Income Module use data from abovementioned registries; the systems were worked out and managed in cooperation with private IT companies. Data exchange between information systems was enabled by state-level infrastructure X-Road. Information about services is available on the Tallinn website in the Tallinn Public Service Database http://www.tallinn.ee/eng
To reduce the digital divide, the newly established Estonian Broadband Development Foundation, which has among its founders Estonian telecom providers, mobile operators and other companies, announced a joint initiative to develop superfast broadband infrastructure by 2015. The action plan, called EstWIN, aims at connecting every household and business to the new fibre-optic network capable of offering 100 Mbps speeds. Building the network will require an investment of EUR 383 million, most of which will be covered by the telecom companies, with some of the funds coming from the government. Estonia also has a Wi-Fi network covering 100 % of the territory. Much of this wireless connectivity, especially in urban areas, is provided free of charge, but a number of ISPs offer flat-rate access packages. There are 353 public Wi-Fi hotspots in Tallinn City
The Tallinn City Planning Proceeding System was first launched in autumn 2005 and has since made work and life of city clerks and habitants more pleasant and productive. Applications for local area planning today are submitted via web portal, and proceeding process is transparent in real time to the extent determined by law. There is practically no human errors any more, work productivity has been doubled and queues of nervous citizens waiting to ask questions from clerks are all past by now. This system combines GIS with workflow and document management technology, with good results. Several commercial applications for area security, feet control and solid waste management have been developed later, using the same platform
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

Service 1	**Public service database:** with 580 services, online payment and applications mapped with service providers and 2012 quality certificate 'best practice' from EIPA. Most services are fully online, including registration of businesses or residence, tax declarations and payment of fees or fines
Service 2	**Public transport information:** mobile web application, with online predictions, timetables, route planner, web map, parking, etc. **Free public transport:** registered Tallinn residents benefit from free public transport. This measure was combined with the introduction of a 'green smart card' to identify eligible passengers, a mobile payment system for parking fees (through apps or SMS), an increase of parking fees and the expansion of dedicated bus lanes

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Service 3	**Excavation information:** information tool, providing updated information about excavations, temporary closed-off streets or other interruptions. This information is available to the public via the Tallinn webpage
Service 4	Applications for local area planning are submitted via web portal, and proceeding process is transparent in real time to the extent determined by law. This system combines GIS with workflow and document management technology, with good results Several commercial applications for area security, feet control and solid waste management have been developed later, using the same platform
Service 5	In municipal housing construction, Tallinn follows the principles of energy efficiency and the city also has a support programme for energy-saving renovations for large apartment buildings

Please describe the measures on organisation, policy, funding and business model of the smart city development

The overall development of Tallinn as a smart city and a green city is headed by the city council as the legislative body and highest governance structure in local government. The city council approves the city budget and adopts the various city development documents, which direct its short- and long-term development. The council also works through its committees, in case of smart city and green strategies, most particularly the Innovation Committee. As the executive body, the city government has a more direct hand in guiding and coordinating smart city development, setting policies, initiating projects, etc. Specific departments are each responsible for their fields in city development, e.g. transport, municipal engineering, city planning, health and social care, etc.

The City Planning Department is in charge of the city planning process, both in carrying out day-to-day planning functions and drafting the city master and thematic plans, in accordance with the planning act and Tallinn construction code. To ensure cross-departmental collaboration and cooperation, however, all drafts and decisions have to be approved by other appropriate city departments. The same system applies for any given field of city development process. To advise the city government on and coordinate the development of ICT and city services, Tallinn City government created the Tallinn IT Council. This council's tasks were to plan IT development strategies, coordinate ICT development between city departments, suggest new innovative projects and cooperate with state bodies on these subjects. The council membership included high-ranking city officials, representatives from state bodies, universities and leading local ICT companies

In 2013, Tallinn intensified the inclusion of its citizens in the city development process. The 'Tallinn Positive Programme 2014–2018' (an important detailed short-term city development document) was compiled entirely based on the ideas and proposals of citizens and NGOs. In preparation for the transfer to free public transport, a local referendum informed and involved citizens into decision-making, providing the municipal administration with the strongest possible mandate for implementing free public transport and decisions aligned with that policy (expanding dedicated bus lanes, implementing green smart (contactless) card, raising parking tariffs, etc.)

Tallinn City budget alongside with EU structural funds has an essential role in Tallinn's smart city development funding. Tallinn has used EU support for several innovative projects, such as development of a digital city statistics atlas, development of a payment portal, SMS-notification system and GIS map application for the city's digital public service database and the aforementioned excavation works and temporary street closure information system

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The free public transport system for city residents provides major incentives for the actual residents to register their place of living in the limits of the city, establishing for all residents another evident link between the paid taxes and the services they get. Raising parking tariffs in the city centre as average by 20 % serves the aim of decreasing car traffic and provides funding for running public transport. The merger of two municipal public transport companies into one business unit provided some savings from administration and improved the central management of public transport
Tallinn's performance and success in reaching its development goals are measured by a comprehensive system of performance indicators in the city's development plan. Well over 120 indicators cover all areas of city development and as all indicators have been assigned yearly target result values, they are also monitored yearly. A comprehensive performance report is compiled based on these result values and is then presented to the city council. The performance report is a valuable tool to direct future city development and plan for amendments to the city development documents
Some examples of Tallinn's performance indicators: export of travel services in Tallinn, percentage of high school graduates, number of public transport users, city credit rating, increase in the volume of interactive services provided by the city, etc.
Tallinn has participated in the European Green City Index study and ranked 23rd there

5.2.13 Venice, Italy

The general situation of the economic and social development of the city
The City of **Venice** has physical peculiarities due to its nature of 'amphibious' city: half spread on water (Venice and its islands) and half on the mainland (Mestre, Marghera and other districts). These two halves are connected by a bridge (road and rail) nearly 4 km long. The city is spread over an area of about 417 km^2 between the lagoon and the mainland and has 270,000 residents, 25 % of which is over 65. Every year more than 20 million tourists visit the city. Moving from one part of the town, for instance, from the island of Pellestrina to Tarù Trivignano, by public transport, it takes more than 2 h
In particular, the Venice lagoon is made up of over a hundred small islands besides Venice itself and the main inhabited islands: such as the coast of Lido (17,848 people.) Murano (4968), Pellestrina (4,471) Burano (3,267), S. Erasmo (771), Mazzorbo (364), the Vignole (69), Torcello (25), Mazzorbetto (10) and San Clemente (1). In San Giorgio Maggiore, San Lazzaro degli Armeni, San Michele and San Francesco del Deserto, hosting convents, there are, respectively, 11, 22, 11 and 9 residents
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
The City of Venice is defining an Action Plan for Sustainable Energy (PAES), a document containing the city strategy for the reducing of greenhouse gas emissions on the territory of at least 20 % by 2020 compared to 2005. The city project involved the major players operating in the territory: universities, transport companies, health authority, associations, etc. The goal is to reduce CO2 emissions to 338,893 t per year that is the 22.67 % of the total emission calculations for 2005. The project is monitored by an indicator or CO2 emissions

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The City of Venice has joined the Green Digital Charter Protocol which commits the signatory cities to work together to achieve the EU's objectives on climate change, through the use of information and communication technologies (ICT). The initiative was launched in 2009 by the City of Manchester and is coordinated by EUROCITIES and has the support of the European Commission. The City of Venice joined on May 4, 2012, by Resolution of the Board signed on May 5, 2012, during the Green Night in the Northeast
For the implementation of the charter, the European Commission has funded under the 7th Framework Programme for R&D the Project NiCE (Networking intelligent Cities for Energy Efficiency – connecting smart cities for energy efficiency) which provides for the training of officials and study visits in the most advanced cities in the field of the innovative use of ICT for energy efficiency
The administration aims to leverage ICT to induce behavioural change for reducing emissions, including those produced by these technologies themselves. Large-scale pilot projects aimed at improving energy efficiency decrease by 30 % in 10 years are to be developed
The City of Venice adheres to the 101 actions of the national digital agenda derived from the EU commitment defined in the communication 245/2010
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Broadband (fixed and wireless) network: since 2009 the City of Venice has invested approx. 12 M euros on broadband by developing 185 Km of proprietary fibre-optic network interconnecting its buildings, other city departments, the university and the public transport relevant sites. Approximately 215 Wi-Fi antennas are granting free flat access to the Internet to all residents and city users. The Wi-Fi network is available for visitors at a low price
Data centre infrastructure: the data centre is the heart of the City's ICT system. It is based on an infrastructure appropriate to the class of services provided (safety and electrical continuity, intrusion, fire and air conditioning technical areas). More than 150 physical servers and 110 virtual systems are hosted in the data centre that is interconnected via a multimode fibre-optic cabling 10GbE. Over the last year, several actions have been carried out in terms of 'server consolidation' through the adoption of virtualisation technologies. The data centre is aggregating other smaller data centres that other local bodies used to run independently (Insula, Casino)
Geographical information system technology: the City of Venice is making an increasing use of GIS systems and technology. More and more geodata are managed and published online, and a new system for monitoring the boat traffic along the Venice canals is being released. The city has developed the project cofinanced by the Ministry of the Interior for urban security, by integrating the existing video surveillance network in the municipal area with new video surveillance cameras
The ICT infrastructure is shared with other partners belonging to the municipal system (ACTV, Ames, Insula) or external (GARR, La Biennale di Venezia)
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)

Service 1	**ARGOS project (Automatic Remote Grand Canal Observation System):** a video surveillance system for boat traffic monitoring, measurement and management along the Grand Canal of Venice. This system meets the specific requirements for the boat navigation rules in Venice while providing a combined unified view of the whole Grand Canal waterway. A specific software has been developed, based on the integration of advanced automated image analysis techniques
Service 2	**Open data:** the municipality of Venice published in late 2012 an open data portal, which is gradually publishing the entire city's datasets

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Service 3	**Tide Forecast:** through the city portal people can access information about the tides in the Venice Lagoon. By subscribing (for free) to an alert service via SMS and/or by email, users receive a daily bulletin with updated forecasts. A free app (HiTide!) for Android and iOS is also available for informing about the current tide and forecasts
Service 4	**Venezia Unica:** a city pass offering the possibility to its possessor to use the services of public transport, buses and water buses and trams, public access to Wi-Fi, restrooms, the people mover, bike sharing and park and municipal parking lots and visit the exhibitions of the civic museums all with a single smart card. The city card can also be purchased by tourists
Service 5	**IRIS (Internet Reporting Information System):** a web 2.0 communication channel between citizens and the public administration allowing citizens to report online and geo-locate the needs for urban maintenance in the city. The system is active in the Municipality of Venice since May 2008. The public administration has the opportunity to receive detailed information on the status of the territory and on sensitive issues for the citizens. Citizens can participate in the care of their territory and evaluate the performance of the PA understanding the reasons and motivations

Please describe the measures on organisation, policy, funding and business model of the smart city development

Consumer protection: the city has a consumer protection service that provides initiatives for those who do the shopping and go to school and for the elderly. In addition, the municipality is the promoter for the project 'Venice for the alternative economy' run jointly with the association AEres (the association of the various realities of Venetian RES), which provides a permanent round table involving all the subjects who participated in the construction of the Venetian RES (paper for the Italian network of solidarity economy)

Regulations and standards: the regulations and standards document contains minimum requirements relating to the methods of service delivery and compliance with quality standards defined by the administration. It is an 'agreement' between the citizen and the city council regarding a specific service delivered. Among the regulations and standards for the services which can be mentioned is the Wi-Fi – public free Internet connectivity. The document informs users about the service level for Wi-Fi offered by the city and to the ways to access it

Cockpit: the City of Venice has participated in the 2011–2012 call for this EU research project, funded by the European Commission. Cockpit aimed at the elaboration of a methodology and implementation of a prototype of a web platform for the codesign of public services between citizens and public administration

Regulations on open data: approved by resolution of Council no. 41/2013, Approval of the Regulations on the publication, ICT access and reuse of public data (open data) D. Lds. 82/2005 – Digital Administration Code

5.2.14 *Vilnius, Lithuania*

The general situation of the economic and social development of the city

Vilnius is the capital of Lithuania and its largest city, with a population of 539,939 (806,308 together with Vilnius County) as of 2014. Vilnius is the seat of the Vilnius City Municipality and of the Vilnius District Municipality. It is also the capital of Vilnius County. Vilnius is the major economic centre of Lithuania and one of the largest financial centres of the Baltic States. It is home to only 15 % of Lithuania's population but generates ca. 40 % of Lithuania's GDP. GDP per capita (nominal) in Vilnius city is $24,456, while GDP per capita (PPP) is $35,175 (2014 estimate), making it the wealthiest city in Lithuania and the wealthiest city in Eastern Europe

Currently in Vilnius there are growing local advanced solar and laser technology manufacturing centres (such as photovoltaic elements and renewable energy producers). In 2009, the Barclays Technology Centre was established in Vilnius, which is one of four strategic engineering global centres. Furthermore, Vilnius concentrates most on Lithuania's education and social infrastructure, attracting over two-third of Lithuanian creative industries. These conditions have led the city to grow at the fastest rate in the Baltic

Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions

The City of Vilnius has three principal aims:

- Modern, open, interactive city
- Enhanced quality of city services
- New technologies simplifying the ordinary life

The smart city strategy for the City of Vilnius is being developed and the city is in the process of uniting different initiatives for the city. The city has a strong political support from the city council to deploy as many smart city projects as possible when implementing the city strategic plan for 2020. The strategy is to be prepared and approved by the city council by the end of 2014

Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city

The City of Vilnius is one of the top five leading cities to have the fastest Internet connection in the world. The fibre Internet can be found in the significant amount of households and fast 4G LTE Internet is being deployed across the city

Lithuania has a very high IT IQ and a very fast adoption rate of the new available technologies. It also has above-average penetration of mobile devices connected to the Internet. The IT infrastructure in Vilnius corresponds to the highest international standards: there are several multinational IT service centres located in Vilnius, including Barclays, Western Union, CSC and others. Therefore, the data centre infrastructure is being well developed in the city as well. The centres that match the standards of Uptime Institute Tier III or II levels are in operation in the City of Vilnius

The city collects and updates GIS information on the daily basis. Moreover, different sets of information can be found in the interactive Vilnius map on the website of the city

The most important city data is public on www.vilnius.lt: Vilnius city plan, detailed plans, permissions for constructions, traffic jams, traffic restrictions, bicycles paths, schools and outdoor cafes

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The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**E-school** – pilot project in 8 schools of Vilnius based on student ID Integrated e-ticket Passing control Library system Micropayments in the school canteens (no cash in the future)
Service 2	**M payment system** **m.Transport** system will include m.Ticket, m.Parking and m.Taxi apps. The m.Ticket allows commuters to buy mobile tickets, plan a journey and see the live timetables of the public transportation. The m.Taxi is one of the easiest ways to call for a taxi in the city just by several clicks on the smartphone. The m.Parking which has a start-stop function that allows users to pay only for the exact real parking time and forget about coins that were needed to be paid into parking machines which is expected to be used by half of the car drivers in the following year. The developed apps can be easily scaled to different cities as well as presented as a good practice to learn from. The goal of the apps was to make the services more user friendly and handy
Service 3	**Unified public transport** 'Vilniečio kortelė' (Vilnius Citizen Card) unites all the public transportation systems. Furthermore, backed up by numerous research and citizen's polls, the public transportation system has been improved – fast track buses started operating in the city and dozens of new vehicles were acquired to make journeys more comfortable, and time-limited electronic tickets now allowed users to change the vehicle without being additionally charged as it was when the city used paper tickets. Therefore, the whole system has become more efficient, convenient and user-friendly. What is more, the new card could now be used even for renting a bike – a new means of public transportation (rent and share system of orange bikes was implemented in the city). More than 440,000 people now have the Vilnius Citizen Card in their wallets
Service 4	**Vilnius City open data portfolio** is currently providing a large set of open data assets. In particular, there are available data sets regarding e-democracy tools, interactive city maps, mobile city apps, urban issue registry, centralised registration to preschool organisations, schools' sports halls renting system, city hub café for e-ideas, safe city, etc. All are set under the umbrella of an initiative known as general 'Smart Vilnius' strategy. With this broad portfolio of data sources, Vilnius expects to create a healthy ecosystem with four main features Deliver raw open data to companies to develop applications while generating new opportunities and added value to the city (economic push) Deliver applications and services to citizens at an affordable cost by the administration Offer new services to the citizens produced by the public administration Promote transparency in the public administration

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Service 5	Future smart city applications are currently in the planning phase such as: Electronicisation of all services of the Vilnius City Municipality Smart energy consumption – application which allows to measure the consumption of the energy, compare it in the timeline, with the neighbours paying the bills Vilnius citizen card – (discount system for the Vilnius citizens, who have declared the living place in Vilnius and whose taxes go to Vilnius city budget) Interactive city – (free Wi-Fi + smart touch screens – multifunctional information – city events, tourist information, city news)
Please describe the measures on organisation, policy, funding and business model of the smart city development	
'Smart Vilnius' is a newly established body to coordinate smart city initiatives of the City of Vilnius. It does this in cooperation with the Vilnius City Municipality (the mayor, the city council) – the policymakers and the city municipal government administration (E.City dept., City Environment and Energy dept., City Transportation dept., City Development dept., City Investments dept.) – administrative and implementation body	
The Municipal Enterprise Susisiekimo Paslaugos (transport services) is a local public transport authority that has been directly responsible for smart mobility projects. The enterprise manages the public transportation system, parking system and traffic control, maintenance of routes' network, passenger ticket control, support and maintenance of information system for passengers and gathering and analysis of data on passenger carriage within the city and issues and sells public transport tickets	
Vilnius City government introduced the e-democracy platform, which involved citizens into decision-making processes of the city. The website of Vilnius was developed to give all the information on city board meetings agenda and now allowed citizens not only to inform themselves on issues discussed by the city but also to express their opinions and suggestions by participating in polls or enabling them to prepare e-petitions	
This environment also allows users to easily report city problems both online and via mobile application and watch how the problems are being solved by the city services or even check different open data on the interactive map of the city and vote for the topics that are in the city council's agenda, comment council's decisions and documents and interact with the council members	
The platform also makes it possible to order electronic documents and get online services from the city government – residents and local business can choose more than 100 electronic services provided by the city: from licencing to applications for the kindergarten	
The City of Vilnius presented a user-friendly website of the city, www.vilnius.lt, where citizens can find all the useful information about the city, the newsfeed and the e.participation platforms. Moreover, the city opened the e-ideas hub on the first floor of the city municipality building – an open space for the citizens to communicate, get help with the e-services, organise events, etc.	
Smart city development projects are being funded mostly by the budget of the City of Vilnius (especially for smart mobility), EU funds (e.g. e-ticket system) and PPP (e.g. complete street lighting modernisation) projects. Moreover, the city also participates in different initiatives which provide indirect benefits for the city – e.g. IBM's Smarter Cities Challenge (expertise valued at $500.000)	

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Example for PPP structure: the City of Vilnius will be modernising its street lighting over the next 2 years. The project will be implemented through a public-private partnership by Gemmo S.p.A. of Italy and is considered to be one of the best-practice examples in the European Union. High-efficiency modern LED lighting fixtures will reduce energy consumption in Vilnius, the capital of Lithuania, by more than 70 %. The advanced technology implemented through a PPP (public-private partnership) will save over two million euros annually on electricity
There are different companies that were and are deploying various projects. The Traffic Monitoring and Management System was deployed by Siemens and partners; the e-ticket system was deployed by the company EM TEST; mobile solutions are being developed by local companies as Itero, NFQ Solutions and Mediafonas; the complete modernisation of the city lighting will be made through a public-private partnership by Gemmo S.p.A. of Italy

5.2.15 Zagreb, Croatia

The general situation of the economic and social development of the city
 The City of **Zagreb** is the capital city of Croatia and its dominant urban, administrative, political, financial, economic and educational centre. A total of 790,017 inhabitants live in 17 city districts. In addition to Zagreb with 688,163 inhabitants and Sesvete with 54,085 inhabitants, the administrative area of the City of Zagreb also encompasses 68 settlements with a total of 47,768 inhabitants. Zagreb attracts the majority of daily commuters from its regional surroundings, over 100,000 those travelling to Zagreb for work or education. Average salaries per employee in the City of Zagreb are 18 % higher than the state average
Zagreb accounts for one-third of the Croatian GDP. In 2012, the average unemployment rate in Zagreb amounted to 8.7 % and was among the lowest compared to other cities and counties in Croatia (Croatian average, 18.1 %). Zagreb accounts for 33.2 % of investments at national level. GDP indicator per capita is at EUR 20,000, which is 85 % higher than the national average. In 2010, Zagreb had GDP per capita which was in real terms around 9 % higher than the EU-27 average. Budgetary revenue of the City of Zagreb accounts for 30 % of the direct revenue of the state budget. The industry sector today accounts for 14.3 % of the newly added value, whereas trade leads with 22 % share, followed by financial services and insurance with 13.2 % share, professional, scientific and public services and the ICT sector which is experiencing significant growth
Does the city have a strategy, plan or action for the smart city development? If so, please provide a brief overview of document, such as the innovative concept, targets and main actions
The City of Zagreb has adopted a strategic development document called **City of Zagreb Development Strategy – ZAGREBPLAN.** The vision of the City of Zagreb as an urban incubator is achieved by relocating the boundaries in all significant areas of work and action, as deemed important for the city, by applying an entrepreneurial approach. The vision is also created through synergic action for the purpose of creating six designated strategic development goals: (1) a competitive economy, (2) development of human resources, (3) environmental protection and sustainable management of natural resources and energy, (4) improving urban quality and functions of the city, (5) improving the quality of living and (6) improving the system for managing development

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As one of the first European capitals, the City of Zagreb has joined the Covenant of Mayors initiative, showing the will and commitment to go beyond the EU energy targets. It is also part of the Networking intelligent Cities for Energy Efficiency **(NiCE)** programme to promote and advance implementation of the commitments of the Green Digital Charter (GDC). The proactive energy policy of the City of Zagreb has set high targets in order to meet the obligations set out in the Covenant of Mayors and the sustainable energy action plan of the City of Zagreb to reduce CO_2 emissions by 21 % through the application of energy efficiency measures and the use of renewable energy sources by the year 2020
Sustainable energy action plan of the City of Zagreb (SEAP), adopted in 2010 and reaching until 2020, is the key document for the implementation of energy efficiency, renewable energy sources and environmentally friendly fuel projects at the city level and the City of Zagreb City Office for Energy, Environment and Sustainable Development is responsible for its implementation. The obligations from the sustainable energy action plan of the City of Zagreb refer to the entire territory of the City of Zagreb, both public and private sector. The plan defines a number of necessary activities in the buildings, traffic and public lighting sectors; Implementation of the planned measures will lead to 21 % reduction in CO_2 emissions on the city territory
The ICT System and e-Governance Development Strategy of the City of Zagreb for period 2014–2020 aims at establishing Zagreb as a leading city and a reference model for the development of new concepts and the use of advanced technologies in its functioning but also as a provider of high-quality services for citizens. It has the goals (1) to provide better services to citizens, (2) to develop IT resources in an organised and cost-sensitive manner, (3) to increase the work efficiency, (4) to focus on green working, (5) to provide direct access and (6) to be innovative. The ICT strategy is aligned with the overall development strategy ZAGREBPLAN
Please describe the policies, actions and outcomes/impact of the ICT infrastructure sharing, information sharing and service platform sharing across smart city projects from the smart city
Ultrafast Broadband Network of the City of Zagreb forms the basis for ensuring ultrafast Internet access and allows telecom operators to provide new services. **Wi-Fi network of the City of Zagreb** – Construction of the metro Wi-Fi network with ability to transfer large amounts of data to increase efficiency of usage of mobile devices and improve the quality of life in the City of Zagreb
The energy management information system of the City of Zagreb enables implementation of measures and activities in the building sector and leads to an effective decision-making process. Buildings that need refurbishing the most and the measures required to implement the actions set in the Zagreb are easily identified. Monitoring, analysing and reporting energy consumption are three essential elements of effective energy management information systems (EMIS). Energy and water consumption information from energy bills and energy and water consumption from metering devices are two main sources of information in EMIS. To effectively monitor energy consumption, this data is being calculated with basic and advanced calculations in the analytical part of EMIS. Reporting the users on how the energy or water is consumed in their objects is also important because in the end they are the ones that are consuming energy and water so they have to be informed on how they do it. Only with clear picture of how much energy and water buildings consume is it possible to make improvements and in the end energy and water savings. As a result of EMI usage, the city was able to prepare many projects related to the implementation of energy efficiency measures in the building sector and keep track of their effectiveness

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Hack Zagreb is a hackathon dedicated to building software for the people of Zagreb by the people of Zagreb. Its aim is to bring together citizens, entrepreneurs and developers to solve challenges relevant to the citizens of the City of Zagreb. The goal is to collaboratively create and build solutions using publicly released data, code and technology	
The typical smart city service or application of the city. Please describe the progress and the assessment of each service (less than five services)	
Service 1	**Zagreb Energy Efficient City (ZagEE):** the overall objective of the ZagEE project is to implement energy efficiency measures and renewable energy sources in buildings owned by the local public authority (City of Zagreb). The ZagEE project can be divided into two specific investments: refurbishment of public buildings and public lighting. The refurbishment of public buildings will include standard energy efficiency renovation measures but also the installation of renewable energy sources (solar panels and collectors) on the very same buildings. The modernisation of public lighting will be the first project of such size in Croatia which will feature LED lamps with regulation during late-night hours. The total foreseen investment is EUR 29.4 million. The value of the ZagEE project amounts to EUR 1.813.438, and the total planned investment worth of work on the realisation of planned measures for which the technical documentation will be produced amounts to EUR 29.379.114. The return on investment, without using the grants, is approximately 13 years
Service 2	**E-services** for citizens provide e-communication between citizens and the city, e.g. *Mayor Answers* – citizens can address questions to the mayor directly; *My Zagreb* provides a possibility for citizens to report, revise and comment irregularities in the city and to receive a feedback on how these problems were addressed (primarily dedicated to utility irregularities); *Info-service for Citizens*; etc.
Service 3	**ZG-GeoPortal – Zagreb** spatial data infrastructure is a form of web portal that provides access to spatial information and various related services (search, browse, download, transformation, service discovery, etc.)
Service 4	**PRESTO:** promoting cycling for everyone as a daily transport mode; the project was co-funded by STEER programme (energy aspects of transport), duration 05/2009–01/2012. The five participating cities with varying levels of cycling mode share – Bremen (Germany), Grenoble (France), Tczew (Poland), Venice (Italy) and Zagreb (Croatia) – provided an ideal testing arena to address the undeveloped potentials of cycling and to finally deduce specific lessons learned and general recommendations from their activities. PRESTO activities focused on improved infrastructure planning and targeted promotion to encourage the use of bicycles (including pedelecs, i.e. electrically assisted bicycles)

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Service 5	**i-SCOPE:** the latest generation of 3 days of Urban Information Models (UIM) can be used to create smart web services based on geometric, semantic, morphological and structural information at urban-scale level, which can be used by local governments to improve decision-making on issues related to urban planning, city management, environmental protection and energy consumption based on urban pattern and its morphology, to promote inclusion among various users groups (e.g. elder or diversely able citizens) through services which account for barriers at city level and to involve citizens at wider scale by collecting geo-referenced information based on location based services at urban scale Based on interoperable 3D UIMs, i-SCOPE delivers an open platform on top of which it develops, within different domains, three 'smart city' services. These will be piloted and validated, within a number of EU cities which will be actively engaged throughout the project life cycle. The services will address: Improved inclusion and personal mobility of ageing and diversely able citizens through an accurate city-level disable-friendly personal routing service Optimisation of energy consumption through a service for accurate assessment of solar energy potential at building level Environmental monitoring through a real-time environmental noise mapping service leveraging citizen's involvement will act as distributed sensors citywide measuring noise levels through their mobile phones
Please describe the measures on organisation, policy, funding and business model of the smart city development	
The City Office for Energy, Environment and Sustainable Development was established in 2009 as a department which coordinates city's efforts in energy efficiency, sustainability, conservation of environment and renewable energy. The development agency of the City of Zagreb has launched an initiative for the development of smart city platform of the City of Zagreb	
The City of Zagreb participates in the Future Policy Modelling Project – FUPOL (2011/2015) – aimed at developing advanced ICT tools for modelling policies, predicting the consequences of these policies, the development of new models of governance and cooperation of all stakeholders in addressing complex social problems	
CIVITAS ELAN – duration 9/2008-10/2012; the cities of Ljubljana (Slovenia), Ghent (Belgium), Zagreb (Croatia), Brno (Czech Republic) and Porto (Portugal) joined together in the CIVITAS ELAN project 'Mobilising Citizens for Vital Cities'. They have agreed on the mission, 'to 'mobilise' their citizens by developing with their support clean mobility solutions for vital cities, ensuring health and access for all'	

Chapter 6
Analysis of EU and China Pilot Cities

The information provided by the EU-China pilot smart cities was analysed to provide an assessment of their level of maturity – basic level or 'more advanced' level – with respect to the key characteristics of a smart city. Details of the criteria used to assess the level of maturity are provided in Annex 5. In addition, the key strengths and areas where some further development may be required were noted.

It should be noted that the assessment is based on the information provided by the pilot smart cities in the 'Smart City Assessment Framework' (see Fig. 4.1). ***Therefore, in some cases, the assessment may not accurately reflect the current position, for example, where insufficient information was provided by the pilot city.***

6.1 Assessment of China Pilot Cities

6.1.1 Haidian District, Beijing

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment						√
Business models			√			
ICT infrastructure				√		
Smart city services			√			

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_6

Smart City Strategy Haidian District has introduced a series of documents such as *Smart Haidian Development Program*, the *Smart Haidian Top-level Design* and *Smart Haidian Construction Program*, to specify the main contents of Smart Haidian such as development goals, key tasks and implementation steps. Smart Haidian aims to build smart administration, smart parks, smart urban areas, smart homes and IT industry leadership with local features. The *Smart Haidian Top-level Design* has planned the construction of network infrastructure and cloud infrastructure, framework and main content for intelligence support platform application accordingly and specified the application of mainstream technologies in infrastructure construction.

Stakeholders Haidian District Government takes full responsibility for the construction of Smart Haidian. The Haidian Smart City Industry Alliance (an intermediary body), project management unit, consulting and design unit and deputies to the NPC participate in the decision-making process. The stakeholders covered all related partners. In terms of public participation, Haidian has clear action plans which can motivate the citizens to actively take part in the smart city services and thus forms the mutual interaction. Firstly, it solicits public suggestions through websites; second, it can better receive public feedback, for example, a survey information system platform of the Bureau of Statistics for integration of urban and rural households based on smartphones built in the Haidian District statistics collection system enables residents to keep accounts and upload data via mobile applications; third, a crowdsourcing model has been applied to design the smart city projects, for example, a resident may improve the trader information in the one-quarter service circle surrounding the community via the website.

Governance To ensure the coordination in the urban planning and development, the Smart Haidian construction leading group (hereinafter referred to as the leading group) has been set up with officials of Haidian District bureaus and industry experts as the members. A third-party project management agency with relevant qualifications (hereinafter referred to as a third-party agency) commissioned by the District Office of Economy and Information Technology assists in the *Smart Haidian Top-level Design*, project review and construction management. In terms of governance, Haidian formed a cross-sectorial coordination system with clear division of labours.

Funding Haidian District Government has set up a "Construction Fund of Smart Haidian", which is used for the construction of information infrastructure, database, application system, application platform, etc. The construction funds mainly come from the district government grants. Projects are funded through bidding by the government according to the general government funding cycle, which makes the funds safe and controllable. In addition, Haidian mobilises social capital by using service leasing, BOT and other ways.

Value Assessment There is no corresponding information provided.

Business Models The Build and Transfer (BT) and Build Operate and Transfer (BOT) models are adopted for basic network and data centre construction.

Infrastructure By the end of 2012, the Haidian District fibre-optic network household coverage reached 62.78 %, and the wireless communication network coverage was 97.1 %. It now has 2700 video cameras, and it has built a district spatial data sharing platform. China Mobile has launched 4G services. Haidian has an advanced infrastructure.

Typical Applications Haidian District has achieved the government data exchange, business collaboration and resource sharing by carrying out intelligence application system construction in government administration, urban management, parks, education and health and significantly improved precise urban management, fast processing capabilities, etc.

6.1.2 Binhai New Area, Tianjin

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment			√			
Business models				√		
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Binhai New Area has prepared and issued the *Notice on the Issuance of the 12th Five-Year Plan of Tianjin Binhai New Area Informatization* (Jinbinzhengfa [2011] No. 50), *Notice on the Issuance of the Medium-Term Implementation Program for Smart Binhai Construction* (Jinbinzhengfa [2012] No. 26), *Notice on the Issuance of the Plan of Tianjin Binhai New Area for Cloud Computing Application and Industrial Development* (Jinbinjingxinfa [2012] No. 68) and *Binhai New Area Big Data Action Plan (2013–2015)*; it has published the *Binhai Cloud Action Plan* and carried out the *Research on the New Generation IT Industry Development of Binhai New Area*.

Stakeholders In the Smart Binhai Construction, the main stakeholders involved in decision-making processes include Binhai New Area Government, relevant functional government departments, functional area management committees, basic telecom operators, IT companies participating in Smart Binhai Construction and Binhai New Area citizens. First, it encourages public participation with crowdsourcing, for example, establishing the application of crowdsourcing based on

geographical information map in the Sino-Singapore Tianjin Eco-City; independently developing the Universal Inspection System for Eco-City, through which the municipal, energy, environmental protection and communication departments and property management agencies as well as residents may upload the problems found in the city via pre-installed app. Second, in a game way, it creates a virtual eco-city community map for citizens with real identities to visit the virtual world, synchronises information of traders in the virtual and real worlds via O2O (Online to Offline) and inspires public participation with discounted services.

Governance The organisational structure of Binhai New Area Smart City Construction consists of the smart city construction leading group, smart city construction leading group office and specific departments. The leading group acts as a smart city construction decision-making and coordinating body; the leading group office is responsible for implementation; the informatisation functional department is responsible for overall construction of smart city information infrastructure; each business department undertakes specific construction tasks; and the advisory committee of experts is responsible for providing operational guidance.

Funding The smart city development is funded by the government and business investment. It is directly invested by Binhai New Area Government and strives for national and Tianjin municipal financial support. The business investment includes BT model by the government to attract business investment and self-directed business investment.

Value Assessment In terms of economic development, Binhai New Area has experienced an average annual economic growth of over 20 % in recent 3 years, with the total of used foreign capital reaching US$25.5 billion and of domestic capital of 141.6 billion yuan. In recent years, Binhai New Area has reduced energy consumption by 1.53 million tons of standard coal and unit GDP energy consumption by 4.1 %.

Business Models Binhai New Area adopts a variety of construction and operating models. At present, the government purchases social services and rents facilities and cloud services to boost infrastructure layout construction.

Infrastructure By the end of 2012, Binhai New Area had laid 663,400 km fibre optic, with the broadband cable network penetration rate of 40 %; covered all the urban core areas with WLAN or Wi-Fi, with broadband wireless network coverage of urban core areas being 100 %. China Mobile began to offer 4G service in Tianjin. The completed Binhai New Area Administrative Cloud Centre (Phase I) provides a convenient cloud management platform, 10-gigabit high-speed switching network, overall security and China Unicom and China Telecom dual 100 M Internet bandwidth access.

Typical Applications Binhai New Area has built an e-government cloud centre and a cloud computing services platform, a GIS platform carrying base map data, a work safety emergency management system, a public security emergency command and control system. In addition, the utility operation and maintenance centre built in

the eco-city has achieved the sharing of data, services, knowledge and information. The Tianjin Harbour Industrial Park, with a safety and environmental emergency platform, employs enclosed park management and storm-water outfall online monitoring.

6.1.3 Pudong New Area, Shanghai

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding				√		
Value assessment				√		
Business models				√		
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy It published a smart city construction plan *iPudong 2015 – The12th Five-Year Plan of Pudong New Area for National Economy and Informatization*. The key tasks can be summarised as Campaign 3935, i.e. building a moderately advanced infrastructure system (three plans), enhancing the efficient application demonstration system (nine projects), establishing a solid smart industrial system (three tasks) and developing the environment and security system (five measures).

Stakeholders The government (including the district government and relevant bureaus), research institutions and expert teams, land developers and citizens mainly participate in the decision-making processes of government-led projects, and at the same time the views of some operators and integrators are referred to. In terms of public participation, first, Pudong has carried out the 'My advice for the Smart City' and other activities to encourage people to contribute their wisdom to smart city construction; second, it makes people feel the convenience brought by smart city by taking the form of museum and experience centre; and third, it judges the effectiveness of smart city construction by incorporating the public perception into the evaluation system.

Governance Pudong has established a Smart Pudong building and organisation leadership structure. A working group has been established based on the Leading Group for Pudong New Area Smart City Construction and the Joint Conference for Pudong New Area e-Government Construction to promote the Smart Pudong programme by making full use of leadership, decision-making and coordinating

functions. At the same time, action plans have been made by the district, each bureau, subdistrict, town and development zone according to the progress of Smart Pudong and basic conditions of industries and fields, and relevant work is incorporated in the annual target assessment system.

Funding Currently, the Pudong New Area Smart City Construction projects can be divided into government-led projects and market-oriented (enterprise-based) projects, and the government-led projects are mainly funded by fiscal budget. The main source of social investment comes from funds from enterprises and bank loans, etc. Meanwhile, Pudong New Area is also actively promoting the PPP construction operating model. Approximately 30 billion yuan was planned for a 3-year investment according to the *Three-Year Action Plan for Smart Pudong (2009–2013)*, with 1 billion yuan from government investment and 29 billion yuan from social investment.

Value Assessment Pudong New Area Smart City Construction plays a greater role in promoting industrial development. In terms of urban management, smart city construction achieves a transition from plane management to three-dimensional management in urban safety, traffic management, environmental protection and other aspects by building a more efficient and orderly urban management model and relying on the Internet of Things, cloud computing and other application philosophies and Expo Urban Best Practice concepts and technical achievements. It has released a smart city index system 1.0 and smart city evaluation index system 2.0.

Business Models Currently, Pudong New Area employs a government-led and community-based smart city construction investment model. For example, in terms of infrastructure, it is mainly funded by China Telecom and other operators and subsidised with regard to construction and operational inputs in some hotspots, such as main public areas, via purchase by the government. In addition, as for the projects with distinct market characteristics and good predictability of earnings, enterprises are encouraged to establish a sustainable development model through operations and services in full accordance with market-based mechanisms.

Infrastructure By the end of 2012, it had covered 1,545,000 urban households with the city optical network; basically built a 3G network covering the whole region through wireless city, with the total base station number of 6113 and Wi-Fi places of 2469, and promoted free Wi-Fi hotspot services in 68 public areas. The Lujiazui Wireless Financial City Application Platform was formally launched, and in the convergence of three networks, digital transformation services were provided to 790,000 cable TV users and 314,000 IPTV users.

Typical Applications In terms of low carbon, it carries out building energy audits and monitoring of submetering by using the gateway of industrial Internet of Things and builds intelligent systems in public transportation, medical and other industries. It has basically built an e-government frame system, the integrated information system for administrative examination and approval has achieved online examination and approval on 123 items, committing itself to shortening the approval time from

statutory 22 working days to an average of 8.4 working days; the basically built underlying databases of demography, legal persons and geographical information can be shared between bureaus, subdistricts and towns.

6.1.4 Yangzhou, Jiangsu Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment				√		
Business models			√			
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy The *Smart City Construction Action Plan* developed by Yangzhou has proposed to implement seven action plans and 28 key projects.

Stakeholders Headed by the mayor, with relevant government departments, communications and broadcasting operators as the members, the informatisation leading group makes decisions for Yangzhou Smart City Construction management. An expert advisory mechanism, consisting of well-known enterprises, research institutes and authoritative domestic and international experts and scholars, has been established, and the public can interact on smart city development in a variety of ways like 'China Yangzhou' portal, 'Mayor's Mailbox' and 'Hotline 12345'.

Governance Yangzhou has established a Smart Yangzhou organisational system and an informatisation leading group composed of a number of departments responsible for coordinating 'Smart Yangzhou' construction and hired authoritative experts and scholars from domestic and international enterprises, research institutes and industries to build a Smart Yangzhou experts advisory committee.

Funding The government sets aside a special fund of 60 million yuan each year for the public information project construction and performance evaluation. Yangzhou is working to broaden the investment and financing channels and plans to gradually build up a Smart Yangzhou investment and financing model with government investment as the guidance, business investment as the main body, active support from financial institutions and broad participation of private capital.

Value Assessment Yangzhou Smart City Construction has produced real results in promoting energy-saving and emission reduction and enhancing comprehensive

utilisation of resources, for example, unit GDP energy consumption fell by 5.09 % in 2012 compared with 2011. At present, it has not established a system framework to measure the social return on investment. It has formulated the *Smart Yangzhou Evaluation Index System V1.1* and put forwards 66 key indicators to measure infrastructure, public administration, economic development, human sciences and public perception of happiness.

Business Models The strategic cooperation agreements signed between the municipal government and telecommunications operators and professional IT service providers enable extensive cooperation in infrastructure and public service applications and other areas through market-oriented means such as BOT/BT.

Infrastructure Currently, Yangzhou City has an Internet export bandwidth of 360G, fibre broadband of 8 M in cities, 4 M full coverage in rural area, 3G network coverage of 100 % in cities and 71 4G sites completed by the end of 2013 and provides experience on some buses. The municipal cloud computing centre, put into operation in 2012, has completed integration of server rooms and information systems in 59 municipal departments. In the next few years, Yangzhou will accelerate integration of infrastructure and data resources.

Typical Applications Yangzhou has begun to provide characteristic applications in the municipal cloud computing centre, social sharing platform for comprehensive taxation, digital city management trials, urban intelligent public transportation and other aspects. In addition, intelligence applications have been carried out in education, environment, food safety, health and other areas.

6.1.5 Nantong, Jiangsu Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment			√			
Business models						√
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Nantong City has developed a series of documents such as the *Smart City Construction Implementation Program*, *the 12th Five-Year Plan for Nantong City Informatization* and *Three-Year Action Plan (2013–2015) for Nantong Information Infrastructure Construction*. Nantong will become an eco-city featuring green, low-carbon, harmony and sustainable development.

Stakeholders Government, regulators, land developers, ICT service providers, system integrators, resources suppliers, transport operators and the public are the stakeholders of Nantong Smart City Construction. An IT application project design contest is organised to increase the degree of public participation by voting.

Governance The Nantong Smart City Leading Group, led by the mayor, consisting of officials from government departments has been established for the overall planning and coordination of Smart Nantong.

Funding Nantong Smart City development fund mainly comes from three aspects: governmental financial investment, investment by urban operators (loans from China Development Bank) and other social capital investment, such as BT. The guiding role of governmental financial investment will ensure funding for key smart city pilot construction projects in terms of urban management and public services.

Value Assessment Smart city construction will have a positive impact on economic development, education and culture, resources and environment, public services, urban employment and other aspects.

Business Models There is lack of relevant information.

Infrastructure Currently, Nantong City has an Internet MAN export bandwidth of 620G and broadband access of up to 100 megabits in part of urban quarters and is building 4G networks. It is expected that in the next 5 years, telecom operators will achieve a full coverage of fibre and 4G wireless networks in Nantong City by investing 10 billion yuan in the construction of broadband networks. Nantong's population, legal persons and geospatial and macroeconomic underlying databases have been basically built. Nantong municipal government is expected to invest 300 million yuan in sensor construction within the next 5 years.

Typical Applications Nantong carries out the construction of education information infrastructure, content platform, application show and smart education evaluation criteria system by giving play to rich educational resources and positively developing smart education applications. Nantong City, featuring rapid smart transportation growth, has developed and adopted a number of information systems such as traffic portal, office automation system and online system for traffic administrative transparency. In addition, Nantong has also carried out smart city applications in environment, health, logistics, public administration and other aspects.

6.1.6 *Huai'an, Jiangsu Province*

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy		√				
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment						√
Business models						√
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Huai'an City has put forwards a development vision in environment, energy, transportation, waste management and other aspects.

Stakeholders Government and ICT service providers mainly participate in the decision-making processes. The public makes suggestions through an open information platform.

Governance The Smart Huai'an construction leading group is responsible for the coordination of smart city construction.

Funding The smart city public infrastructure projects are funded by the city government, and professional application systems are funded by the government and enterprises in varying proportions based on different operating models.

Value Assessment There is lack of relevant information.

Business Models There is lack of relevant information.

Infrastructure Huai'an is building 4G networks and plans to build 400 4G sites by 2013. In addition, it is also planning to build the government cloud computing centre, wireless e-government network, geospatial information system, etc.

Typical Applications It carries out applications in food safety, health, public administration and other aspects, but the variety is not rich.

6.1.7 Ningbo, Zhejiang Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment				√		
Business models			√			
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Ningbo has introduced the *12th Five-Year Development Plan of Ningbo for the New Generation of IT Industry*.

Stakeholders Ningbo has set up special leadership and consultation mechanisms, covering decision-making, coordination, implementation and supervision. Citizens participate and provide advice in the design, development and promotion of smart city services.

Governance Ningbo has set up a smart city construction leading group and 5 groups for pilot project promotion and coordination. Ningbo maintains close partnerships with domestic and international top universities and research institutes in smart city development and has established a smart enterprise institute, an institute for intelligent system development and an international smart city research centre.

Funding The current smart city development is mainly funded by the government, businesses and social funds, and the government fund plays a leverage role to attract more investments from private sectors.

Value Assessment Ningbo measures smart city development with the Chinese Smart City Development Evaluation System. Its counties (cities) and districts measure smart city development with the Ningbo Smart City Development Evaluation System.

Business Models Ningbo Government implements the Public Free Internet Access project by providing 1 GB of free data per month to the public through lines leased from telecom operators to stimulate needs and guide telecom operators.

Infrastructure Ningbo has a total of over 2.38 million broadband users, has covered more than 2.7 million households with optical networks and set up a TD-LTE leading group for 4G infrastructure construction. In addition, Ningbo has achieved data sharing and cross-sectorial applications in the underlying population database, legal entity underlying database and natural resources and geospatial underlying database of ICT infrastructure.

Typical Applications Ningbo actively promotes smart city applications in smart health, logistics, city management, social security, security, transportation, etc., and takes advantage of ICT infrastructure to achieve integrated cooperation of business. Smart health is a preceding smart city construction project for the people's well-being. Smart transportation uses big data technology to conduct urban traffic data analysis, improve the scientific level of urban planning and urban traffic management and reduce traffic pollution emissions.

6.1.8 Jiaxing, Zhejiang Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment			√			
Business models						√
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Jiaxing City has developed the *Smart City Development Plan (2011–2015)*, with the goal to strive to basically build broadband, converged, secure and ubiquitous information technology infrastructure by 2015 to achieve broader intelligence application in administrative, commercial and well-being fields and build a number of key demonstration projects and large-scale smart industrial bases to form the basic framework for smart city development.

Stakeholders Jiaxing Government, ICT service providers and the public are all the smart city construction stakeholders. The public is the biggest beneficiary who demands, experiences and participates in the construction. It is publicised through the city media, public service ads, relevant events (Smart City Expo China) and other ways. New business application training and guidance are provided through communities and associations.

Governance Jiaxing City has set up a smart city construction leading group and its office and established the Jiaxing Smart City Institute and its first group of affiliated institutes by integrating the Zhejiang Institute of Advanced Technology of Chinese Academy of Sciences, Yangtze Delta Region Institute of Tsinghua University, Zhejiang, No. 36 Research Institute of CETC, Jiaxing University, etc.

Funding It is funded by the government on the one hand and by commercial entities on the other hand.

Value Assessment It has moderately increased business opportunities and employment opportunities by 10 % and GDP by about 8 %. It has moderately eased traffic congestion and reduced CO2 emission by about 440,000 tons. It has established a new model to facilitate appointment and diagnosis through online booking, telephone booking, telemedicine and other ways.

Business Models There is lack of relevant information.

Infrastructure Jiaxing has 1,173,900 Internet users, an Internet export bandwidth of over 550G and basically full coverage of city area with 100 M fibre-optic network; it has 100 % 3G network coverage of the whole city and has started a smooth transition to 4G networks. It has begun to implement a project of Wi-Fi coverage of urban public spaces for people's well-being. It has gradually built a public cloud computing data centre, a cloud computing infrastructure and service platform facing different industries and a wireless city application data centre and application platform.

Typical Applications Jiaxing has proposed to build a smart application system in 10 main aspects of production and living, including smart administration, well-being, transportation, grid, health, city management, culture and education, environmental protection, logistics and tourism. Smart grid: the first commercial solar photovoltaic power generation demonstration base in Zhejiang Province has settled in Jiaxing. Smart transportation: a citywide taxi-call system and a traffic portal integrating the networks of the provincial, city and county transportation authorities have been built.

6.1.9 Zhangzhou, Fujian Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment			√			
Business models				√		
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Zhangzhou City actively implements national and provincial policies such as the *Action Plan of Fujian Province to Speed Up the Development of the Internet of Things (2010–2012)* and the *Action Plan of Fujian Province to Speed Up the Development of the Internet of Things (2013–2015)* and promotes Zhangzhou

Smart City Construction by advancing the industry demonstrating application and industrial cluster development, accelerating core technology R&D and building support systems.

Stakeholders Zhangzhou Smart City Construction is mainly led by the government, with joint participation of operators and technical support enterprises and collection of opinions from relevant enterprises and the public.

Governance Zhangzhou has set up a smart city construction leading group and its expert group and the Smart Zhangzhou construction team responsible for providing technical support for smart city construction.

Funding Proposals are made by specific operators for government-funded projects; funds are raised by enterprises for commercial projects based on the progress; BOT and other patterns are employed for government-financed projects, which are supported by charges on users and post-supervised by the expert group and price department.

Value Assessment Zhangzhou has carried out a preliminary assessment on smart city construction, which encompasses two main parts, namely, social and economic benefits.

Business Models In addition to government-funded projects, Zhangzhou has actively explored a variety of business models. The model of government procurement of services is adopted according to the actual use to give some support to the project of public nature. The project that the user requires frequent use of value-added telecom services should be funded by the operator solely or in cooperation with the developer and maintained by the charge on value-added telecom services during operations.

Infrastructure Zhangzhou has a broadband access rate of over 90 % and a wireless broadband coverage of over 90 %. Zhangzhou is pressing on with the coverage expansion of 3G mobile base stations, improvement of urban optical networks, enhancement of broadband network coverage and bandwidth, extension of broadband networks to rural and other remote areas and active promotion of 4G mobile communications construction. In addition, Zhangzhou has made great progress in infrastructure sharing and built fairly comprehensive information resource sharing mechanism.

Typical Applications Zhangzhou, with its smart city applications based on digital city, has achieved information sharing and business collaboration by gradually integrating resources. In terms of e-government, it has built the cross-sectorial Government Services Platform. In terms of digital city management, it has established a unified platform of overall perception, intelligence analysis, information sharing and collaboration for urban management. In terms of security video surveillance in urban areas, it has built a citywide monitoring platform. Finally, it has built a convenient service information platform for Zhangzhou residents for one-stop payment and inquiry of household bills.

6.1.10 Yantai, Shandong Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment			√			
Business models						√
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Yantai Government issued the *Advice of Yantai People's Government on the Implementation of Informatization City Strategy* and the *Advice of Yantai People's Government on the Development of Emerging Strategic Industries*. The promotion of Smart Yantai construction through the implementation of informatisation city strategy makes the urban environment more liveable, energy more efficient, transportation more smooth, urban operations more intelligent and people's life happier. But there is no specific strategy or plan focused on smart city.

Stakeholders Its main stakeholders include all levels of government functional departments, businesses and citizens. Among them, the public is mainly responsible for suggestion and supervision, which is how they participate in the smart city construction, but there are no specific ways and clear channels for the public to share advice, give feedback and get involved in the design process.

Governance All the departments and areas are unified under the leadership of the city informatisation leading group for smart city construction collaboration and formed a coordinated system.

Funding The investment needs about 1–2 years to complete. First, Yantai Government has set the smart city fund and eliminated worries of investors. Then the implementation of active industrial policy will attract more social capital.

Value Assessment Yantai has already conducted a preliminary evaluation in water resources, air environment and city noise and other areas, but has not yet introduced a smart city assessment system.

Business Models There is no specific information on business models.

Infrastructure Yantai has an Internet export of 340G, which has covered all administrative villages; has 1,198,700 broadband Internet users, more than 1,742,500 landline telephone users, 8,334,800 mobile phone users and more than 900,000 cable TV subscribers; and has built more than 1900 4G base stations.

Typical Applications Yantai has carried out a lot of intelligence application services, including smart education, digital environmental protection, food safety traceability, smart logistics, digital urban management, smart transportation, etc., in which smart transportation system is the best practice. It provides guarantees for Yantai intelligent traffic management and services through the establishment of video surveillance system, traffic camera system, barrier system, traffic signal control system, traffic acquisition system, traffic guidance system and mobile police system. For example, the traffic signal control system for public transport priority in Yantai will sense a bus when it reaches an intersection and extend the green time for the bus.

6.1.11 Nansha District, Guangzhou, Guangdong Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment			√			
Business models						√
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy The *Top-level Design Scheme of Nansha District on Smart City* formulated by Nansha District in 2013 is used to guide the construction of Smart Nansha. It plans to build a general framework for Smart Nansha top-level design on four layers – perception, transport, knowledge and application – and makes a plan for each design task based on the four levels, which covers 15 intelligence applications in three main areas of urban management, people's well-being and industry.

Stakeholders The key stakeholders of Smart Nansha are the government, research institutions, information technology consulting and design units, operators, system integrators, citizens, etc. In terms of interaction with and participation of the public, it has put forwards an innovative concept of data operations. On a data operating platform functioning as the data store constructed by the government, citizens can upload, download and use a variety of data and easily purchase available government data (of hydrology, environment, public facilities, etc.) according to the prices, while the data providers can make money for selling the data.

Governance A Smart Nansha leading group headed by the district governor was established to be responsible for leading and coordinating smart city management;

validating top-level plan, design, implementation programme and total budget for smart city management and construction; coordinating the management resources of major cities and urban intellectual infrastructure construction; supervising the implementation of major tasks; identifying significant issues to be reported to the district government; determining the division of responsibility and authority of smart city management; and coordinating the relationship between different departments and towns and subdistricts to promote efficient smart city management.

Funding It is planned that about 90 % of Nansha District Smart City Construction funds come from the government and about 10 % from enterprises, while there should be more private funds in practice.

Value Assessment A preliminary assessment on Smart Nansha encompassing environmental, social and economic benefits indicates that there are neither relevant quantitative indicators nor specific assessment system.

Business Models There is lack of relevant information.

Infrastructure Nansha District has an Internet capacity of 30GB/s, with an Internet access rate of over 73 % and over 600 WLAN access points, with a signal coverage rate of more than 98 %. 4G networks have full coverage of the core area. Two types of video cameras achieve full surveillance without dead angle, including around 1200–1300 cameras installed by town and subdistrict police stations and the cameras by government departments (such as Water Authority and the Flood, Draught and Wind Prevention Office).

Typical Applications Nansha has launched smart home service, smart community service and smart park projects and simultaneously planned smart environmental monitoring, healthcare and education projects which have not yet been deployed, so it belongs to basic in terms of maturity. The Smart Public Lighting Management Platform implemented in 2012 has received one international award (final award of the Innovative Initiative category at the Barcelona Smart City Expo World Congress 2012) and six domestic awards (such as Guangdong new technology product certification, MIIT smart city innovation application award and 14th China Hi-Tech Fair excellent product award) since R&D, which is the best practice in Nansha.

6.1.12 Qianhai Shenzhen-Hong Kong Cooperation Zone of Shenzhen, Guangdong Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		

(continued)

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Governance				√		
Funding			√			
Value assessment				√		
Business models				√		
ICT infrastructure		√				
Smart city services		√				

Smart City Strategy Qianhai Shenzhen-Hong Kong Cooperation Zone has formulated the *Smart Qianhai Planning Outline, Smart Qianhai Master Plan, Smart Qianhai Overall Design, Recent Action Plan for Smart Qianhai* and *Smart Qianhai Standard Evaluation System* and a series of special plans for infrastructure, smart administration, city management, transportation, finance, water town, logistics, security, industry, community, building, medical care and education and clearly set quantitative targets to comprehensively guide smart city construction.

Stakeholders Qianhai Authority, as the coordinator, planner, standard maker and supervisor for smart city construction, attracts operators, manufacturers, suppliers and private capital, Hong Kong, Macao and Taiwan funds and foreign funds. In terms of public participation in smart city business design, Qianhai provides third-party developers and the public with an open application development platform through an open suite and application aggregation platform and, at the same time, develops a bonus-point scheme to encourage public participation data sharing. The higher the bonus gained, the user can have more competence to share more data. In the smart city plan, QianHai includes the channels for citizens to participate in smart city services.

Governance Qianhai has established a Smart Qianhai working group, with its Smart Qianhai office responsible for the daily work and four teams in programme planning, investment and construction, operation and maintenance and promotion and application. A ministerial co-presence conference has been established at the national level and a Smart Qianhai expert group has been set up under the Qianhai Advisory Committee in order to ensure overall coordination.

Funding Qianhai has three funding channels: (1) special funds established by the government; (2) private funds, Hong Kong funds and foreign funds attracted by the government investment via the injection of capital, subsidised loan, financing guarantee and service outsourcing subsidisation; and (3) cross-border loans and financing in Hong Kong through land sale and government bonds.

Value Assessment Qianhai set up a long-term standard evaluation system to fully grasp the characteristics and influencing factors at different stages of Smart Qianhai development, including infrastructure, IT application and services and construction

management, and to calculate and evaluate the results in urban management, administrative services, industrial development and emission reduction.

Business Models In the field of infrastructure, it shares risks by establishing a joint venture company, Qianhai ICT Development Co, Ltd. The main body for the Smart Qianhai infrastructure construction composed of Qianhai Authority together with the top three carriers and RFT updates associated facilities and uses a partial outsourcing model that enterprises participate in the construction and the government purchases services, PPP, equipment rental services and other outsourcing models. It employs a market-dominated investment pattern for wireless city, e-commerce, smart logistics, finance and business and other profitable smart city services.

ICT Infrastructure Qianhai is at a rising phase of municipal infrastructure building and just started with information infrastructure construction. According to the plan, Qianhai public broadband access capability will reach 1Gbps by 2015, that for commercial buildings and modern service areas will reach 100Gbps, and the co-construction and sharing rate of video cameras, sensors and data storage computing devices in public areas will be 100 %. But by the end of 2013, Smart Qianhai had not extensively started ICT infrastructure construction, so it is still in basic state.

Typical Applications Smart Qianhai is still at the planning stage and only has very little applications. It has formulated 11 special applications such as smart water town rich in water culture interactive applications, smart education with smart sensory interaction, smart buildings with centralised monitoring over building energy consumption, unified cold source arrangement and solar materials applications, smart medical care with personal health project management system, disease prevention information system and epidemic announcement and surveillance system, but smart city applications had not been completely established as of the time of submission, so it is still in basic state.

6.1.13 Hengqin New Area, Zhuhai, Guangdong Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance				√		
Funding				√		
Value assessment			√			
Business models				√		
ICT infrastructure			√			
Smart city services		√				

Smart City Strategy The *Digital Hengqin Special Plan, Smart City Construction Master Plan of Zhuhai* and other documents released by Hengqin New Area have made a detailed plan for communications infrastructure networks, geographical information system, underlying database, information security system and infrastructure co-construction and sharing to ensure that the city plan includes major technology trends of smart city and specifies quantitative indicators.

Stakeholders In the construction process, different construction phases have different stakeholders. At the early stage, smart city is dominated by the government, with the final decision-making authority vested in the central and local governments and regulators; at the later stage, it will be gradually commercialised. The government and regulators will mainly play a guiding role, while application will be led by market demand. The range of stakeholders that participate in the decision-making processes will further extend to professional service providers, ICT service providers, the public, etc. The public is the demand side who needs to experience the program, while there is no channel for feedback and participation in business design. That's why an evaluation of average has been awarded.

Governance The smart city programme is under a development leading group and an expert committee. The leading group that establishes coordination mechanism sets up an office responsible for daily coordination, major project audit and major project supervision and management.

Funding It can be funded by the national, provincial and municipal investment, including Hengqin public fiscal and fund budget, and also be financed through BT and social (private) investment. It is expected that 40 % will come from the government, 30 % from financing and the rest from value-added services in cooperation with enterprises. At present, most comes from Zhuhai and Hengqin governments, operators and other land developers.

Value Assessment Hengqin has put forwards indicators in population, GDP, economy, environment, society and other aspects and has made a preliminary assessment on pollution and emission reduction in transportation, logistics, environmental protection, waste disposal, water supply and other areas, but has not yet established a smart city assessment system. So it's listed in average.

Business Models Hengqin explores a variety of business models according to specific smart city construction projects. If a risk-sharing plan is implemented for wireless base station construction, the operator will invest in base facilities and participate in the sharing of future revenues; if commercial models like BT/BOT and PPP and private investment are introduced in information system construction, the enterprise will be responsible for construction, operation and maintenance of information systems and will have the ownership of the assets invested and make profits from advertisements and value-added services.

ICT Infrastructure Currently, it has the longest utility tunnel for ICT infrastructure construction in the country, which may save 3–4 billion yuan compared to traditional ICT pipelines. It plans the construction of wireless base stations as a whole

and has built 20 shared radio base stations at the first phase. Video surveillance, smart sensors and other infrastructure will be built separately for sharing according to a product catalogue to be developed, and perceptive information will be open to the urban public support platform for information sharing and unified management. However, infrastructure construction is still at a planning stage in Hengqin Island and therefore cannot be fully assessed.

Typical Applications New to Hengqin Island, smart application has just started with electronic fence for shoreline monitoring and inspection, online duty drawback, bond and tax break, 3C green intelligent substations, online government service centre, geography space frame, etc. Because Hengqin is a greenfield, it has not yet formed a wide range of smart city applications, so it's listed in the basic level in terms of maturity.

6.1.14 Chengdu, Sichuan Province

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment			√			
Business models				√		
ICT infrastructure				√		
Smart city services			√			

Smart City Strategy Chengdu has issued a series of ICT plans, including the *12th Five-Year Plan of Chengdu for National Economic and Social Informatization, Plan of Chengdu for Internet of Things Development (2010–2012), 12th Five-Year Plan of Chengdu for Cloud Computing Application and Industrial Development*, *Demonstrating Application Program of Chengdu for the Internet of Things, Guide to the Commercial Cloud Computing Services of Chengdu, 12th Five-Year Plan of Chengdu as Famous China Software City* and *Outline of Chengdu for Communications Hub Construction*, but has no overall plan or vision for smart city construction, and hence, an average level has been awarded.

Stakeholders Chengdu Smart City Construction, led by the government, combines business entity construction and market-oriented operation. Public feedback channels include mayor's hotline and mailbox and open public service platform, as well as government microblog and other Web 2.0 new media channels.

Governance A work pattern and management system have been formed for the Chengdu Smart City project under the leadership of the city informatisation leading group with the coordination by the city information technology administrative authority, performance of duties by associated departments and active participation by the community and enterprises. At the same time, it cooperates with Sichuan University and the University of Electronic Science and Technology of China on software personnel training and with the Optical Fibre Research Centre of Fudan University on application of fibre WAN dynamic monitoring technology.

Funding The government investment and financial assistance give priority to support for basic, public, demonstrating and innovative projects for people's well-being. Simultaneously, private and foreign funds are attracted to smart city construction through capital injection, subsidised loans, service outsourcing subsidies and financing guarantees. Information infrastructure projects are mainly funded by telecom operators, and public service platforms are mainly financed by the government. Chengdu has added the evaluation on use of financial funds into the government target assessment from the beginning of this year and established the fund monitoring schemes.

Value Assessment Chengdu has put forwards to strengthen the performance assessment on government investment in information technology projects and is working on project application performance evaluation mechanism to strengthen supervision and inspection of project construction and operation and to improve project quality and efficiency in the use of government funds, but has not yet established an assessment system for Smart Chengdu.

Business Models Chengdu adopts different business models for different areas. Information infrastructure construction is self-financed by telecom operators; pure public service projects like public service platform are fully funded and directly run by the government, which charges the public little or no money for the services provided; basic projects involving well-being services are run on BOT or BLT by the government. In addition, Chengdu plans to explore congestion charging on the basis of dynamic intelligent transportation and use it for the development of public transport system.

ICT Infrastructure Chengdu implements unified planning, construction and maintenance of information infrastructure to encourage all the projects to make full use of existing computer rooms, networks, storage and computing resources and other information infrastructure. Chengdu has a total Internet room area of over 80,000m^2, which can accommodate more than 10,000 frames and has more than 10 large IDC rooms; Sichuan cloud resource pool of the western information centre of China Telecom, western China's largest cloud resource pool, has an external service capability of 3500 cloud hosts, 250 T storage and 100G export broadband; it has about 36,000 city video surveillance devices in public places. From 2013 to 2014, Chengdu utilised Huawei's cloud platform to develop the first industry cloud in the southwest region of China. The platform serves over 2000 enterprises in Chengdu's 21 industrial campuses. The innovative BLO operation mode helps these campuses

lower the investment costs by 55 % in ICT system development. It achieved full 4G coverage in the urban centre by the end of 2013, so it gains the level of more advanced.

Typical Applications Chengdu has some smart city applications, but mostly in start stage. In terms of public safety, it has established a significant hazard monitoring system and a dynamic monitoring system for fireworks; in terms of intelligent transportation, it has implemented trunk road network traffic video capture, traffic video surveillance, traffic incident detection, traffic guidance and other intelligent applications; in terms of food safety, it has established a meat and vegetable tracing system; in terms of environment, it has built an online direct reporting and monitoring and early warning system of emissions data and a torrent forecast and early warning system; in the field of energy use, it has built an intelligent urban lighting management system for Internet of Things for intelligent control of urban street lamps.

6.1.15 Korla, Xinjiang Uygur Autonomous Region

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance				√		
Funding			√			
Value assessment		√				
Business models				√		
ICT infrastructure			√			
Smart city services			√			

Smart City Strategy Korla City is one of the cities that take the lead in smart city planning and construction in the western regions, and it leads the way in the smart city strategy among western cities. It has formulated the *Smart Korla Development Master Plan (2013–2015)* and *Smart Korla Implementation Program* and signed the *National Smart City Task Statement for Korla* with the MOHURD, all of which can ensure to some extent that its smart city development is in line with the major technology trends.

Stakeholders Smart Korla has its definite stakeholders. The people's government of Korla is the leader and decision-maker for the Smart Korla construction. The Bayingol Branch of China Telecom is the main participant and promoter. The China Academy of Information and Communications Technology of MIIT, China Telecom Beijing Research Institute and other research institutions are primarily involved in

Smart Korla top-level design and long-term planning. Xianheng International (Hangzhou) IoT Information Industry Co., Ltd., Zhejiang Province Public information Industry Co., Ltd., Xinjiang Public Information Industry Co., Ltd., etc. provide specific design programs with regard to information and intelligent construction for smart city construction, and Korla citizens experience, participate in and give feedback on smart city construction and mechanism innovation, but there are relatively few ways and means of public participation except newspapers and websites.

Governance Korla City has established a Korla informatisation and Smart Korla construction leading group, headed by the Mayor, with eight Deputy Mayors as deputy heads and principal officials from over 30 departments like the city Housing and Urban-Rural Development Bureau, Development and Reform Commission, Urban-Rural Planning Bureau, Science and Technology Bureau, Health Bureau, Environmental Protection Bureau and Transport Bureau as the members. The leading group has set up an office at the Housing and Urban-Rural Development Bureau and a committee of experts, to form a coordinated governance system.

Funding In the investment and financing aspects, Korla has a long-term mechanism: on the one hand, establishing Smart Korla special funds and actively seeking the support of national, regional and Aid to Xinjiang funds and, on the other hand, making full use of the market mechanism and encouraging the active participation of all sectors of society in smart city construction.

Value Assessment As the Smart Korla construction just started this year, there is no value assessment at present.

Business Models Korla Smart City Construction, depending on specific projects, employs self-support, enterprise-building and government-renting, BOT, PPP and other business models. For example, in terms of intelligent transportation construction, traffic ticket fines through the traffic system will be put into the city intelligent transportation system construction. A cross-sectorial information service platform for comprehensive taxation established by Korla enables the city tax department to find valuable tax evasion clues by screening and comparison in order to collect back taxes and late fees and fines for subsequent development of government information systems.

ICT Infrastructure Korla has a home cable broadband penetration rate of 38 % and a corporate customer broadband penetration rate of 76 %. Wireless broadband network penetration rate has reached 34 %, which is behind that of domestic developed cities. In terms of IDC rooms, Korla has a basic geographical information centre room of 126m^2, accommodating 140 servers and storage devices, a Korla E-government Cloud Computing Centre room of 126m^2 and a total of 1000 cameras for security monitoring.

Typical Applications Smart Korla typical applications include intelligent food and drug supervision and management, smart community innovation service, basic geographical information public service, three-dimensional digital city and digital sandbox and three-dimensional auxiliary planning decision, Korla data centre, etc.

6.2 Assessment of EU Pilot Smart Cities

The assessment of the pilot cities level of smart city maturity provided below and the smart city short profiles provided contained in Chap. 5 are based on information provided by the pilot smart cities in the 'Smart City Assessment Framework'.

6.2.1 Amsterdam, Netherlands

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding				√		
Value assessment					√	
Business models				√		
ICT infrastructure				√		
Smart city services					√	

6.2.1.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Amsterdam Smart City ('ASC') programme was set up in 2009 to stimulate innovation and focuses on energy transition and open connectivity in the area of living, working, mobility, open data and public facilities such as healthcare and education. The city's vision is 'Amsterdam is an international frontrunner in the development of a smart city' and the goals of the programme are testing innovative products and services, understanding the behaviour of the residents and users of the Amsterdam and sustaining economic investments. The city has recently launched 'City Dashboard Amsterdam', which is a visualisation of the city's key performance indicators for the following domains: transport, environment, statistics, economy, social, cultural and security.[1] For each domain, the actual status is shown, based on blocks of 24 h, and the data is refreshed every 10 s. The information is captured in charts and graphs and on a map of the city.

The city actively engages with stakeholders to ensure their needs are incorporated into the solution design. A variety of mechanism are deployed to capture citi-

[1] http://citydashboard.waag.org/

zens' requirements including serious gaming to show residents the smart solutions already in existence and to increase the number of bottom-up initiatives.[2]

The ASC was initiated by the Amsterdam Economic Board, the City of Amsterdam, Liander and KPN and has grown into a broad platform, with more than 100 partners. Governance of the programme is achieved by the ASC providing an initiating and facilitating platform for its partners in Amsterdam Metropolitan Area. The ASC connects the needs and wishes of users, residents, government and business and stimulates all parties to take action. This structure is flat hierarchy with regular cross stakeholder meetings taking place at both a project and programme level.

The founding members of the ASC each contribute to the total yearly budget of €400,000 for the overall management of the programme. However, funding for each smart city project is provided on a case-by-case basis with a business model that ensures all costs are recovered during the lifetime of the project.

The city has implemented a system to measure the economic, environmental, social and cultural outcomes/impact from their smart city initiatives. For example, many of the smart city projects have a target reduction in CO2 emission and the city tracks for each project the actual CO2 reduction against the target. The ASC measures the number of jobs created as a result of the smart city initiatives and has developed a method of estimating the financial return on investment on the smart city platform.

Connectivity is an important aspect of most smart city initiatives; investment in high-speed fibre-optic broadband and other basic ICT infrastructure is generally provided by the municipality of Amsterdam. However, some ICT infrastructure may be provided by the partners in a specific smart city project.

More than 50 smart city services have been developed for the City of Amsterdam across five key functional areas: living, working, mobility, public facilities and open data.[3] For each smart city project, there is a clear description of the purpose of the project, the specific location of the project (e.g. specific area of Amsterdam such as Nieuw-West), the key characteristic of the project (e.g. energy display, smart meter, insight in energy usage) and key targets the project is aiming to achieve (e.g. energy efficiency, CO2 reduction, behavioural change).

(b) *Areas for possible further development*

Amsterdam is at the forefront of getting smarter and has won several awards for its smart city development program. While there are no obvious areas of weakness where Amsterdam should focus on as regards further development effort, the city should continuously strive to improve in terms of both providing better services to citizens and enterprises and utilising its resources more efficiently.

[2] The game consists of both online and offline components, giving as many people as possible the opportunity to contribute and contemplate the future of their city.

[3] Details of all the projects can be found at http://amsterdamsmartcity.com/projects.

6.2.2 *Barcelona, Spain*

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy					√	
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment				√		
Business models				√		
ICT infrastructure				√		
Smart city services					√	

6.2.2.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Barcelona has a clear smart city vision and strategy with quantifiable objectives for the environment and energy, transport, waste management, urban-rural cohesion and 'quality of life'. The city has developed KPIs which are monitored by a dedicated department within the city council on a monthly basis. In addition, Barcelona is collaborating jointly with the City of Buenos Aires in the innovative project of the 'Smart City Index' which publicises annual smart city rankings, both internationally and by regions, thus constituting the best possible benchmark for performance evaluation in the smart cities field.

Barcelona engages with a broad range of stakeholders – within Barcelona City Council, local and international companies; research institutes; international institutions such as European Commission, the World Bank and the United Nations; and citizens. Barcelona engages actively with its citizens through various mechanisms such as the Municipal Action Plan (PAM),[4] the smart citizens' platform[5] and hosts hackathons and application development contests as a way of boosting innovation and the creation of new ideas. Social networks are used together with Barcelona City's official webpage to inform and teach citizens about any possible services. In addition a tool – Cibernàrium – has been created to provide technical training for citizens to use the new services.

[4] More than 70,000 contributions from citizen were received in the PAM process.

[5] The smart citizens' platform http://www.smartcitizen.me generates participative processes for the citizens connecting them with data and knowledge with the idea of collectively constructing the city.

In 2011, Barcelona City Council created in a new department the Urban Habitat, under which several areas of the city were grouped – urban planning, ICT, energy, environment, urban services and infrastructure – in order to facilitate good coordination and communication between the various departments and external stakeholders. A key goal of the Director of the Urban Habitat is to find synergies among the various smart city projects and to ensure the smart city strategy is aligned with the long-term vision of the city.

Barcelona assesses the value of projects on both financial and nonfinancial measures, for example, the reduction in GHG through the implementation of smart city projects. In 2014, the city will link the data it has gathered on the impact of smart city development in terms of economic, environmental, social and cultural benefits.

The city council has made and continues to make a huge investment in building an integrated network from the four existing fibre-optic networks and Wi-Fi infrastructure in the city. To ensure sufficient funding, the city council has established a Telco partnership strategy where the partner provides the network maintenance and development of the network, and in exchange, the Telco can utilise the excess capacity for its own use. In addition to the broadband network, there are sensors installed throughout the city for projects such as smart lightning and smart water projects. The ICT infrastructure development is shared across many smart city projects, for example, the integrated network, the Urban Platform[6] and the smart data projects are the bases for other projects. The construction of this network involves high maintenance costs and investment efforts.

Barcelona has implemented over 25 smart city services, which it considers represent 'best practice' across all sectors including logistics, smart lighting, energy and utilities, intelligent buildings, water, waste management, environment, transport, community development, public services, open data, health and education.

Collaboration with other cities is a significant priority for the development of ideas and networks, which Barcelona is facilitating through its City Protocol project.

(b) *Areas for possible further development*

Barcelona is one of the most advanced smart cities in the world. One area where Barcelona may possibly benefit from further development is in the area of securing funding for projects. Currently the city does not have a business plan associated with a smart city project; instead the project is planned in separate parts, with each part allocated a specific budget. Although there does not appear to have been any instances of smart city projects not being able to secure adequate funding to complete the project, this is potentially an area of risk.

[6] The Urban Platform, developed in partnership with Cisco, is a leading integrated platform which allows for the development of functional technological applications to improve the efficiency and quality of services received by citizens.

6.2.3 Bristol, UK

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance			√			
Funding				√		
Value assessment						√
Business models						√
ICT infrastructure				√		
Smart city services				√		

6.2.3.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Bristol has developed a vision for its smart city development, which focuses on 3 key areas, namely, smart energy, smart transport and smart data. The smart city strategy was developed from the output of an independent study commissioned by Bristol City Council and funded by the UK Department of Energy and Climate Change.[7] Bristol City has implemented KPIs for the wider sustainability agenda for environment, energy, transport, quality of life, etc. The city is currently developing the metrics to measure progress of its overall smart city programme as part of its Future City Demonstrator work. In addition, some individual projects, e.g. smart metering, has its own metrics.

The city has a stakeholder group of more than 100 people who have been involved in Bristol's smart city work, which comprises of Bristol City Council, University of Bristol, University of West of England, industry, local and national government, international institutions and other international cities. Bristol takes a 'public, private, people' approach to smart city projects, where citizens work with the public sector, private companies and community engagement organisations in codesigning projects and trialling them. Training is provided for citizens as part of individual smart city projects.

Bristol has implemented a wide portfolio of smart city services in each of the three key areas of focus. Within each of these areas, there are many smart city appli-

[7] The study showed how smart city technologies could contribute to Bristol's carbon reduction objectives, benchmarked Bristol against other world cities and offered a set of objective recommendations that will contribute to further emission reductions and provide citywide economic benefits.

cations, some of which have been deployed for several years and have benefited from feedback from its citizens. In addition some of these services had previously been deployed in other EU cities such as in Germany and Spain and then replicated in Bristol, for example, the 3e-House project. This project involves integrating the most common ICTs into social housing.

(b) *Areas for possible further development*

The City of Bristol recognises there are some areas where there is a need to develop their smart city strategy and has put in place actions to address this requirement. For example, the city has recently commissioned some work to do an appraisal of different business models for commercialising smart city projects.

6.2.4 Copenhagen, Denmark

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders		√				
Governance			√			
Funding			√			
Value assessment	√					
Business models			√			
ICT infrastructure				√		
Smart city services				√		

6.2.4.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Copenhagen has one of the lowest carbon footprints per capita in the world, less than two tons per capita, and also has the most ambitious carbon reduction plan of any major city in the world, aiming to achieve carbon neutrality by 2025. Copenhagen is participating in a vast array of initiatives directed towards the establishment of an ICT infrastructure. The list includes Copenhagen Connecting, Copenhagen Cleantech Cluster, Øresund Smart City Hub and more. More advanced initiatives include the GIS platform and the open data distribution platform, plus the just politically decided ITS platform for the 'intelligent handling of traffic' to be implemented fully over the next 3 years, with a budget of 60 million Danish Kroner per annum.

The city's smart city flagship Copenhagen Connecting has been analysed by an independent consultancy firm to be worth 589 million euro yearly in socio-economic benefits for a citywide deployment.

(b) *Areas for possible further development*

From the information provided in the Smart City Assessment Framework, it appears there are some areas where there may be scope for further development by the City of Copenhagen. For example, the city does not to have any KPIs to measure the performance in meeting the smart city objectives; it does not engage citizens in the design and development of smart city services.

6.2.5 Florence, Italy

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance			√	√		
Funding			√			
Value assessment						√
Business models			√			
ICT infrastructure				√		
Smart city services				√		

6.2.5.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Florence's current vision and strategy for the city incorporate goals and objectives for the environment, energy, transport, waste management and 'quality of life'. The city is proactively developing a strategy of commitment to innovation, where the core concept is a system of interactions between the physical and human layer and digital infrastructure and applications. Although KPIs are not systematically used by the city to measure smart city performance, there are some tools that allow tracking of programme activities and results. For example, the strategic monitoring system provides an ongoing assessment of the programmes' implementation progress and the degree of achieving its stated goals and objectives.

The City of Florence has formed collaboration agreements with stakeholders including public organisations, industry, universities and research centres. The city uses multiple forms of interacting with citizens; it actively seeks their participation in decisions regarding the city and provides transparent feedback on citizens' suggestions and ideas. It has implemented a smart governance system that uses various technological tools that enable stakeholders to communicate in a simple and functional way as a means to improve democratic participation.

The City of Florence has an advanced digital infrastructure including a citywide sensor network, an extensive Wi-Fi network that provides free access for 2 h/day to residents and visitors. The city has implemented many smart city services for a wide range of stakeholders.

(b) *Areas for possible further development*

As no information was provided regarding whether the city has undertaken any form of value assessment, it is possible there could be some scope for possible further development in this area.

6.2.6 *Frankfurt, Germany*

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders			√			
Governance						√
Funding			√			
Value assessment	√					
Business models			√			
ICT infrastructure			√			
Smart city services			√			

6.2.6.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Frankfurt does not appear to have a specific smart city strategy. Instead the city approaches its modernisation strategy from a 'green city' perspective. The vision for the City of Frankfurt is to use modern technology to achieve advancements in energy savings, citizens' lifestyle, modernisation of residential buildings and energy facilities. The city's goal is to reduce the city's CO2 emissions by more than 40 % by 2025 and convert the power supply to renewables by 2050.

Frankfurt engages with a wide range of stakeholders to support the city's climate roadmap. For example, the city has established eClub (www.eclub-frankfurt.de), which is a platform that enables citizens to learn more about their electricity consumption. The platform provides practical advice on how to reduce household consumption and offers financial incentives to encourage citizens to replace old appliances with more energy-efficient electrical devices. Other initiatives to engage with stakeholders include a 'local action plan' to make Frankfurt a model for

electro-mobility by developing an awareness-raising campaign to explain the benefits of e-mobility and to bring civil society up to date.[8]

The City of Frankfurt finances its smart city initiatives through a variety of funding mechanisms and business models. For example, several funds from Frankfurt's Urban Planning and Development Department are used to provide low-interest loans for new residential buildings, modernisation and development and refurbishment work. All programmes contain energy efficiency criteria and allowances for passive houses. The city's energy supplier, Mainova AG, provides subsidies for passive houses, electricity cogeneration and cost-efficient circulating pumps, a thermography service and energy certificates. The City of Frankfurt provides direct support for households, SMEs, professional associations and churches to save electricity. If they save at least 10 % electricity compared with the 2 previous years, the city pays them 10 cents for each kWh of electricity saved. To date, participants have received an average bonus of €70, with average electricity savings of 24 %. The City of Frankfurt has worked with scientific institutions to develop a scheme to build energy needs into an 'ecological rent index', which has resulted in incentivising landlords as energy refurbishment leads to higher revenues and tenants benefit from reduced heating costs.

Frankfurt is in the process of consolidating its IT services in a new data centre, which will use only highly efficient, high temperature-resistant hardware components. The consolidation plan will eliminate redundant software development projects and result in the closure of 30 computer centres. By consolidating their IT services, the city will be able to launch a range of new online services for its citizens and at the same time reduce software costs by 40–50 %.

Frankfurt has successfully introduced innovations in energy, housing and mobility. For example, the city has developed the first publicly accessible 'service stations' in Germany where electric cars can be charged and parked. The city also connects decentralised electricity cogeneration plants with each other so as to offset fluctuations in electricity generation from wind farms and solar systems. A 'solar map' application is offered online from which residents can judge where there are suitable conditions for installing solar panels.

(b) *Areas for possible further development*

There was insufficient information available to assess how Frankfurt ensures all activities relating to the city are coordinated and therefore whether there is a requirement for the city to further develop its governance structure. There was no evidence that Frankfurt has implemented a system to measure the economic, environmental, social and cultural outcomes from their smart city initiatives.

[8] Actions include test and ride sessions with electric vehicles, information stands at local events and a solar charging point at the Mobility Centre. The economic development team has cooperated with the Chamber of Commerce to run seminars on post-oil urban mobility and to foster debate with local businesses and knowledge institutes about the consequences and the opportunities associated with electro-mobility. Source: Urbact Tribune, November 2012.

6.2.7 *Issy-les-Moulineaux, France*

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders					√	
Governance			√			
Funding			√			
Value assessment			√			
Business models						√
ICT infrastructure				√		
Smart city services				√		

6.2.7.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Issy-les-Moulineaux engages with a broad range of stakeholders through conferences and meetings, participatory workshops, polls and calls for testers in the development of new smart services and applications. Citizens are informed every month of new digital projects and are provided an opportunity to voice their opinion through a 'citizen task group' comprising of 900 representative citizens. A *serious* game has been developed to inform a wide audience about the numerous digital services provided by the city.

The city is equipped with high-speed Internet infrastructures and a GIS system. Smart city applications will be migrated to the cloud, starting with applications developed for schools. According to the information provided, Issy-les-Moulineaux is the most important smart grid test territory in France. The plan is to involve 10,000 employees and citizens in order to reduce buildings' energy consumption.

The city has a wide range of smart city applications across most sectors including education, intelligent buildings, open data, public services, transport and culture. The City of Issy-les-Moulineaux is of the opinion that some of the smart city services could be adapted and rolled out to other cities, for example, Digital Fort eco-district,[9] the open data project and the digital technology development tool for education.

(b) *Areas for possible further development*

From the information provided in the Smart City Assessment Framework, it appears there are some areas where there may be scope for further development by

[9] Digital Fort is a new eco-district which combines sustainable development and new technologies (home automation, fibre optic, air-powered collection of waste, straw bale school, geothermal energy, feng shui swimming pool and a digital cultural centre.

the City of Issy-les-Moulineaux. For example, the city does not appear to have any KPIs to measure the performance in meeting the smart city objectives, and it is not clear if there is a citywide governance structures in place with shared performance targets across departments.

6.2.8 Lyon, France

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders					√	
Governance				√		
Funding				√		
Value assessment						√
Business models				√		
ICT infrastructure				√		
Smart city services				√		

6.2.8.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Lyon's smart city strategy addresses all aspects of a smart city including energy, mobility, environment, new public services such as open data platforms for citizens and businesses, economic development, urban planning, and the quality of life improvement for all citizens.

Making citizens central to the strategy is a core principle for the City of Lyon, and it does this in a number of ways by implementing distinct, concrete projects that provide residents with direct benefits. Smart city projects are developed collaboratively and involve variety of stakeholders such as businesses, citizens, academia and institutional partners. The city has experimented with a variety of mechanisms to engage with stakeholders in the development of services including creating data and services dissemination platform to support innovation and new service, crowdsourcing and gamification and hosting workshops to gather new ideas. Lyon promotes the objectives of the smart city approach via a variety of media such as press kits, leaflets, websites, articles in magazines and newspapers, TV, interviews and showrooms to showcase new service. The city has implemented training programmes to help citizens adopt new services; special events have been organised to explain how to use electric vehicles; guide books and individual meetings are provided to sensitise citizens about their energy consumption and explain to them how to reduce it through smart devices.

Lyon's smart city strategy is led by the Economic and International Development Delegation. A technical committee with representatives from all the city departments meets regularly to ensure all activities relating to the smart city are coordinated.

Funding for the smart city projects mainly comes from the private sector (circa 97 % in 2013); some of the investment was from foreign investors. Typically projects are established as public-private partnerships involving the government, academia and industry. A wide range of business models have been implemented such as subscription and advertisement-based models for transport systems.

Lyon has been a pioneer in implementing very high-speed broadband, and coverage is expected to be 100 % by 2019; the city has also been chosen by all mobile operators to provide 4G coverage. The city's goal is to provide a global architecture where ICT infrastructure (network, data centres and data) is shared across smart city projects.

Lyon has developed more than 40 smart city services across to meet the needs of a cross section of stakeholders. At least 50 % of these services have already been implemented citywide. Some of these services are considered 'best practice' and have been implemented in numerous cities around the world (such as Velo'v, a bike-sharing service, which was launched in 2004); Smart Electric Lyon managed by EDF,[10] the largest European Smart Grid pilot project with 25,000 households which comprises of 20 partners, is developing new technologies, business models and citizens awareness of energy consumption.

(b) *Areas for possible further development*

The City of Lyons recognises there are some areas where there is a need to develop their smart city strategy and has put in place actions to address the areas. For example, although the city has not yet introduced key performance indicators to measure the city's performance in meeting their objectives, it is currently investigating existing smart city measurement/ranking systems in order to benchmark and compare Lyon's competitiveness to other cities. Lyon has not yet implemented a value assessment system to measure the outcomes from their smart city programmes although the city has plans to do so.

6.2.9 Malmö, Sweden

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		

(continued)

[10] The EDF group, a leading energy player, active in all major electricity businesses www.edf.com.

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Governance					√	
Funding			√			
Value assessment				√		
Business models			√			
ICT infrastructure				√		
Smart city services				√		

6.2.9.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Malmö has a strong and well-documented vision and strategy with quantifiable objectives for the environment, energy, transport, waste management, urban-rural cohesion and 'quality of life'. The city works systematically towards a long-term perspective centred on sustainable development, with its environmental targets continually monitored, evaluated and reported through its annual environmental report. Malmö's ICT strategy is focused on both maximising digital innovation for sustainable urban development of the city and minimising the environmental and climate impact of the technology.

The city uses multiple forms of interactive technologies to engage with citizens such as websites, crowdsourcing of ideas, SMS, Twitter, etc. Malmö actively promotes and publicises its environmental policies to a wide group of stakeholders by providing climate tips on billboards, introducing climate change to students through participation in workshops building solar cell-driven cars and discussing issues concerning climate, transport and energy. The smart citizen network in Malmö includes representatives from business partners, the city municipality, a housing cooperative, youth groups and several NGOs which include marginal groups such as women and immigrants. A key strand of the citizen engagement strategy is to ensure citizens can 'be seen, be heard' by focusing on enhancing social interaction in local places and expressions of opinion from citizens often marginalised in the public debate and 'visualising energy consumption', which aims to support collaborative understanding of ecologically smart living.

For service innovation, Malmö engages in a series of codesign workshops where ideas are developed in an 'open-source' format and can be taken further by any participant.

The City of Malmö has approved the 2009–2020 Environmental Programme which includes goals for municipal activities, as well as the whole of Malmö. The city as a whole has a shared responsibility to realise the goals and objectives outlined in the environmental programme. There is cooperation between committees, steering boards, government agencies and companies in order to provide a working

system that is simple and coherent. To ensure the city achieves its environmental objectives, quantitative and qualitative indicators set by the committees are developed and monitored.

The Malmö Initiative and Malmö Panel are examples of how the residents of the city participate and influence the content of the municipal decision-making. Via the Malmö Initiative, citizens can make suggestions and comments pertaining to various areas via Internet. One can take up a debate and get support from others involving various issues. The Malmö Panel is a forum for the 1600 Malmö residents that, twice each year, have a say on issues brought up by Malmö's councils.

The city uses a variety of funding sources to finance its smart city initiatives, including EU funding programmes and utilising strategic investment vehicles like JESSICA Urban Development Funds. Malmö collaborates with various government organisations such as VINNOVA,[11] Teknopol[12] and Innovationsbron[13] and public organisations such as Almi[14] for its investments in smart city projects.

With respect to value assessment, the City of Malmö is working together with WWF (Worldwide Fund for Nature) and SEI (Stockholm Environment Institute) to gain a holistic understanding of Malmö's total emissions through the design of the so-called REAP (Resources and Energy Analysis Programme) tool.

Malmö invests about 45 million kroner per year in broadband, and together with the private players, circa 72 % of Malmö's households have a fibre connection today. The city has commissioned two central data centres and is moving towards implementing services on hybrid cloud platforms. The city has a goal of reducing its carbon dioxide emissions attributable to ICT by 30 % by 2020 through strengthening the municipality's environmental, climate and fair-trade initiatives.

In 10 years, Malmö has created several world-leading examples of sustainable construction and regeneration which have actively incorporated innovative greening strategies, including the inclusion of green roofs, green fences (green walls), open storm water management and aquatic-rich ponds as well as tree planting strategies. The city has implemented several smart city services and initiatives across a range of sectors including energy, environment, food safety, intelligent buildings, transportation and waste management.

Of note is the district of Hyllie in Malmö, which is a testing ground for the energy solutions of the future. The city, E.ON (Malmö's primary energy provider) and the municipal authority VA SYD signed a climate contract, where they commit-

[11] VINNOVA promotes collaborations between companies, universities, research institutes and the public sector. Every year VINNOVA invests about 2 billion SEK in various initiatives. The investments made by VINNOVA must have a private counterpart investing at least the same amount as the authority.

[12] Teknopol's mission is to provide start-up companies with advice on HR, IPR and finance from experienced entrepreneurs.

[13] Innovationsbron is owned by the Swedish government and Industrifonden. It functions as an organisation completing the market in early stage and seed investments.

[14] Almi is a public organisation providing entrepreneurs with high-risk loans, venture capital investments and advisory services for entrepreneurs. Almi's role is to complete the capital market without competing with private initiatives on the market.

ted to turning Hyllie into the most climate-smart city district in the region and that its energy supply, at the latest in 2020, will consist entirely of renewable or recycled energy. Five construction companies involved in Hyllie have received SEK 50 million in grants from the EU for a project called BuildSmart in which climate-smart solutions for ventilation, cooling and heating are to be tested.

(b) *Areas for possible further development*

Although Malmö has good high-speed broadband penetration and is moving towards delivering cloud-based services, the city is still working to a relatively old ICT strategy which was approved in 2007. The city has recognised there is a need to undertake a wider ICT strategy review, which will be undertaken next year.

The business model for most of the city's smart city services/initiatives is direct funding from a general budget or from EU project funds, which means the sustainability of the smart city service potentially may be at risk.

6.2.10 Manchester, UK

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance				√		
Funding			√			
Value assessment						√
Business models				√		
ICT infrastructure						√
Smart city services				√		

6.2.10.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Manchester's smart city vision is built around an aspiration to be among the Top 20 smart cities in the world by 2025; the city has developed medium strategies and objectives in the area of transport, planning, climate change, digital and community. Targets have been developed to measure the impact of its smart city development in several areas including creating markets for new technology products and applications, improving the efficiency of doing business by better smart transport, increasing access to health services, engaging people more in how their city is managed,

increasing low- and zero-carbon energy supply, cutting road transport emissions and reducing energy demand and improving the efficiency of supply.

The city has deployed several funding and business models to deliver its smart city development. For example, Manchester has an investment framework which draws together funding from the public and private sector to deliver a pipeline of projects that supports its strategic priorities. This includes European ERDF and the post 2013 programme, regional growth funding, the Greater Manchester Transport fund, the GM pension fund and other private sector investments. Manchester engages with business through existing formal structures and through developing individual market facing projects. Examples of where this approach has been adopted include the expansion of the broadband network, Manchester Airport Enterprise Zone, the Business Growth Hub, Manchester Science Parks and the Green Deal.

Manchester has proven experience of analysing big data for health applications.

(b) *Areas for possible further development*

There was insufficient information provided on the city's ICT infrastructure, and therefore, it was not possible to access whether there is any requirement for further development in this area.

6.2.11 Riga, Latvia

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders				√		
Governance			√			
Funding		√				
Value assessment						√
Business models		√				
ICT infrastructure						√
Smart city services			√			

6.2.11.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Riga's Smart City strategy is in particular formulated through the 'Riga City Sustainable Energy Action Plan for 2010–2020', as well as the Riga Smart City Sustainable Energy Action Plan 2014–2020. Riga's vision involves three themes:

- Planning and Management: Designing and executing a city plan to realise the full potential for citizens and businesses in addition to efficiently running the daily operations
- Infrastructure: Delivering efficient city services that make the city liveable for citizens
- Human: Providing effective services that support the economic, social and health needs of citizens

There are three bodies that are responsible for developing Riga Smart City policy: the management board, which is headed by Riga City Council and includes representatives of citizens NGOs, researchers, energy companies and service companies; the Riga Sustainable Energy Action Plan (SEAP) advisory board, which comprises of leading scientists and experts in the energy and housing sectors; and the coordination group comprising of city departments and city-owned companies.

Riga engages with a wide range of stakeholders in developing its policies for the city. A website dedicated to urban development of Riga City www.apkaimes.lv ('Neighbourhoods') has been set up, which contains information about the city and provides a platform for citizens of Riga to get involved with the urban planning process. The TALKA/CLEAN-UP programme uses the ideas of residents to transfer games from Riga's homes to public spaces such as neighbourhood squares and open areas.[15]

While there was no evidence Riga has implemented a system to measure the economic, environmental, social and cultural outcomes from their smart city initiatives, a set of indicators have been developed to assess the environmental situation in Riga City.[16]

Riga has implemented several smart city-related services in the area of transportation, energy efficiency in city lighting and urban district heating systems.

(b) *Areas for possible further development*

There was insufficient information to access whether there is a requirement to further develop the city's ICT infrastructure.

[15] In the pilot project at Sarkandaugava's Alekša skvērs, residents and designers came up with more than 2000 ideas for outdoor objects and seven concepts for fixing up the square, taking inspiration from familiar table, Internet and TV games such as Ludo, Augstāk par zemi (Feet Off the Ground) and On the Farm. The designers then developed the outdoor objects that are now installed.

[16] The environmental indicators include nature, air, climate change, water, land and use of environmental information systems.

6.2.12 Tallinn, Estonia

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders					√	
Governance					√	
Funding				√		
Value assessment				√		
Business models				√		
ICT infrastructure				√		
Smart city services				√		

6.2.12.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

Tallinn's smart city vision encompasses all fields of city development, including environment, energy, transport, waste management, urban-rural cohesion and 'quality of life'. Tallinn's performance and success in reaching its development goals are measured by a system of 120 performance indicators. A comprehensive performance report is compiled based on the results of the indicators and is regarded as a valuable tool to direct future city development. Tallinn has participated in the European Green City Index study.

Tallinn's citizens, both as individuals and also through non-profit associations and other non-governmental organisations, are consulted in the smart city planning process; state and local legal acts mandate that citizens be informed of the processes and be given the opportunity to participate and submit their proposals. For example, in preparation for the transfer to free public transport, a local referendum informed and involved citizens in the decision-making, which provided the municipal administration with the strongest possible mandate for implementing free public transport and the decisions aligned with that policy (expanding dedicated bus lanes, implementing green smart (contactless) card, raising parking tariffs, etc.). Tallinn employs multiple channels to communicate its smart city developments, including weekly city government press conferences, publicity campaigns (online and print media, posters, etc.) and a weekly European Green Capital-themed newspaper to promote a smart and green mind-set, and Tallinn TV has a dedicated programme for informing citizens about the city's services. To help citizens and enterprises adopt new services, an electronic manual is provided; in addition tutors and training sessions are provided in city public libraries and day-care centres.

The overall development of Tallinn as a smart city is directed by the city council as the legislative body and highest governance structure in local government. The Tallinn IT Council has been created to coordinate ICT development between city departments, suggest new innovative projects and cooperate with state bodies with respect to smart city developments. The council membership includes high-ranking city officials, representatives from state bodies, universities and leading local ICT companies. To ensure cross departmental collaboration and cooperation for smart city development, all drafts and decisions have to be approved by other appropriate city departments. Tallinn employs various ICT solutions to ensure transparency in government, for example, the city council meetings are broadcast live and city government and city council session information systems, including drafts, are open to the public and available on the city website. To ensure accountability, a multi-tier control system is employed.

Funding for Tallinn's smart city development is from a variety of sources including EU support for some projects. Tallinn's free public transport is mostly funded by the influx of new taxpayers.

Tallinn has a system in place for measuring both the financial and nonfinancial value from its smart city development initiatives. For example, as a result of implementing free public transport, the car traffic in city centre has decreased by 15 % which has improved traffic flows, significantly cut down CO2 emissions and reduced traffic casualties.

The city provides a wide range of applications across various sectors including environment, health, community development, open data, public services, tourism, transportation and waste management. Some of the services are delivered over the cloud, are designed with an open Application Programming Interface and utilise data analytics/big data technology.

(b) *Areas for possible further development*

Tallinn has addressed and implemented initiatives for almost all aspects of the Smart City Assessment Framework. Although the city has implemented a wide range of smart city applications, there may be an opportunity for the city to learn from some of the other pilot cities, which have developed a deeper, more advance portfolio of services.

6.2.13 Venice, Italy

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy				√		
Stakeholders			√			
Governance						√

(continued)

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Funding			√			
Value assessment				√		
Business models				√		
ICT infrastructure				√		
Smart city services				√		

6.2.13.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

The City of Venice has a smart city strategy and objectives which include a broad range of areas including energy, environment, transport, waste management, urban cohesion and 'quality of life'. The smart city strategy is underpinned by an ICT strategic plan, which encompasses areas such as infrastructure and security, ecommerce, e-government and open data, digital divide and research and innovation.

The city interacts with a broad range of stakeholders and has introduced several mechanisms to engage with its citizens, for example, a permanent round table involving citizens on the construction of the Venetian RES[17]; free public Wi-Fi access across the city and an EU project called Cockpit with the implementation of a web platform for the codesign of public services between citizens and public administration.

The City of Venice has implemented innovative business models to fund its smart city infrastructure. For example, although citizens are able to access the public Wi-Fi free of charge, tourists pay a fee and the revenues generated are used to maintain the network.

The ICT infrastructure is shared with other partners within the municipality with external organisations. The data centre is the heart of the city's ICT system, which consists of more than 150 physical servers and 110 virtual systems. Over the last year, several actions have been carried out in terms of 'server consolidation' through the adoption of virtualisation technologies:

(b) *Areas for possible further development*

As no information was provided on the governance structure, it is possible there could be some scope for possible further development in this area.

[17] A paper for the Italian network of solidarity economy.

6.2.14 Vilnius, Lithuania

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy	√					
Stakeholders				√		
Governance			√			
Funding			√			
Value assessment	√					
Business models				√		
ICT infrastructure				√		
Smart city services			√			

6.2.14.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

A wide range of stakeholders (municipal government departments, citizens, public and private enterprises, universities, city-owned investment vehicle, etc.) are consulted and/or participate in the design and development of the city's smart services. The city has introduced an e-democracy platform as a mechanism to communicate with its citizen's; information is provided to citizens regarding city services and citizens can provide their feedback by participating in polls or create e-petitions. The platform enables citizens to report city problems both online and via a mobile application; citizens can monitor online progress on how the problem is being resolved.

The City Government Administration plays a leading role in developing smart city initiatives; it has recently established a department 'Smart Vilnius' to coordinate all smart city activities.

A variety of funding methods have been deployed for the smart city initiatives in Vilnius, including public funding, public-private partnerships ('PPP'), EU funding and vendor funding from IBM from its 'Smart City Challenge' programme. Some of the 'good-practice' business models include a PPP, which was established for a street lighting modernisation programme that should reduce energy consumption by 70 % and save the city 2 million euros annually on electricity, and a smart parking application, which resulted in the city council saving money (reduced capital outlay from buying less parking meters, reduced number of administrative hours worked and a reduction in the final price for parking payment by paying only for the real parking time) and enabled the development costs to be recovered in less than 2 years.

The City of Vilnius is one of the top 10 leading cities to have the fastest Internet connection in the world[18]; it is the world's 6th and Europe's number one in terms of Fibre to the Home (FTTH) optic communication penetration[19]; and 4G LTE Internet has been deployed across the city.

The city has developed and implemented a variety of smart city services targeting the needs of stakeholders. The services include, education, energy/environment, community development and public services.

(b) *Areas for possible further development*

The City of Vilnius has not yet developed its smart city vision and strategy. However, the intention is that by the end of 2014, the smart city vision and strategy will have been developed and approved by the city council.

To date there are no formal measures in place to assess the value of the smart city investments in Vilnius, and there does not appear to be a plan to introduce an assessment process.

6.2.15 Zagreb, Croatia

Characteristic	Level of maturity					Not assessed
	Not yet addressed	Basic	Average	More advanced	State of the art	
Smart city strategy			√			
Stakeholders				√		
Governance				√		
Funding						√
Value assessment						√
Business models						√
ICT infrastructure				√		
Smart city services				√		

6.2.15.1 Key Strengths and Areas for Possible Further Development

(a) *Key strengths*

The City of Zagreb has implemented a number of initiatives to ensure citizens are actively engaged in the design of smart city services, such as the introduction of Hack Zagreb, which brings together citizens, entrepreneurs and developers to solve

[18] http://www.china.org.cn/top10/2013-12/04/content_30796020_5.htm.

[19] http://www.eddy.lt/2012/04/top-5-reason-for-geeks-on-plane-to.html.

challenges relevant to the citizens of the City of Zagreb. The goal is to collaboratively create and build solutions using publicly released data, code and technology. The city has also used the latest generation of 3D Urban Information Models (UIM), which have been used to create smart web services based on geometric, semantic, morphological and structural information at urban scale level. UIM has been used by local governments to promote inclusion among various users groups (e.g. elder or diversely able citizens). In addition, Zagreb participated in the CIVITAS ELAN[20] project 'mobilising citizens for vital cities'.

Zagreb is exploring a number of initiatives to improve governance. For example, by participating in the Future Policy Modelling Project,[21] the city is developing advanced ICT tools that it can use to model policies, predict the consequences of the policies and develop new models of governance and cooperation of all stakeholders in addressing complex social problems. The website, My Zagreb, enables citizens to report, revise and comment on irregularities in the city and to receive a feedback on how these problems were addressed.

The city has implemented a variety of smart city services that meet the needs of a cross section of stakeholders. For example, Zagreb has implemented several energy-efficient projects (public buildings and lighting), transportation, e-services for citizens, a web portal providing access to spatial information and related services, etc. In addition the city is participating in a number of EU-funded projects and programmes that are focused on transportation, reducing energy used in urban freight transport, projects of specific interest to Central and Eastern European cities such as fast motorisation, capacity problems in public transport and infrastructure renewal.

In 2012, the city won 2 prizes: European Synaptic Award – first prize in public transport category; European Mobility Week 2012 'Moving in the right direction' – first prize.

(b) *Areas for possible further development*

As no information was provided regarding whether the city has undertaken any form of value assessment or details on funding and business models, it is possible there could be some scope for possible further development in this area.

[20] The cities of Ljubljana (Slovenia), Ghent (Belgium), Zagreb (Croatia), Brno (Czech Republic) and Porto (Portugal) joined together in the CIVITAS ELAN project; a co-financed EU project – duration 9/2008-10/2012.

[21] Future Policy Modelling Project (FUPOL) is an EU-funded research program (2011–2015) with nine million budget.

Chapter 7
Emerging Trends and Open Challenges

Analysis of the information provided by the EU and China pilot smart cities reveals a number of emerging trends and open challenges in the following areas:

- Governance
- Financing
- Business models
- Smart city services
- Technology
- Government policies

7.1 Governance

All pilot smart cities have implemented a governance system. EU pilot smart cities have adopted a more open approach to smart city governance, while most of the Chinese pilot cities have established a smart city leadership group and have adopted the traditional 'top-down' approach.

7.1.1 Key Trends

Some of the emerging trends the pilot smart cities are using to achieve a more participative governance model are given in Fig. 7.1.

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_7

Trend	Example
Citizen engagement	All EU pilot smart cities have implemented various mechanisms such as developing a 'public, private and people partnership' approach in engaging, encouraging and empowering citizens to be more involved in the development of their smart city plans. Some examples of the initiatives taken by the pilot smart cities include Citizens of Issy-les-Moulineaux are informed every month about new digital projects and are encouraged to voice their opinion through a 'citizen task group' consisting of 900 inhabitants representing the population of the city. Inhabitants and companies are also involved through events such as the regional festival of digital innovation, 'Futur en Seine', which was held in June 2013. A serious game[a] was specifically developed to inform a wide audience about the numerous digital services provided by the city More than 70,000 contributions were received from city stakeholders in Barcelona's 4-year Municipal Action Plan Amsterdam has experimented with crowdsourcing on the platform www.AmsterdamOpent.nl to learn how interaction with civilians can support local policies Tallinn employs multiple channels to communicate its smart city developments, including weekly city government press conferences, publicity campaigns (online and print media, posters, etc.) and a weekly European Green Capital-themed newspaper to promote a smart and green mindset, and Tallinn TV has a dedicated program for informing citizens about the city's services Amsterdam, Barcelona and Manchester are participants in the Commons4EU[b] project. This project is focused on promoting openness by the collaboration among cities, civic innovators, volunteers and SMEs in their transformation towards smart cities. The project has and is developing web-based applications that enable the cities to connect with their constituencies in ways that reduce administrative cost and engage citizens more effectively Although not all, some Chinese pilot cities have also designed citizen engagement mechanisms to encourage citizens to be involved in the smart city construction through service trials, training, crowdsourcing and gamification Shanghai Pudong New Area has established the smart city experience hall and experience centre to facilitate citizens to participate in the services and included the evaluation of the citizens into the assessment framework, as a mechanism to assess the smart city services. Pudong has conducted such training as 'smart Pudong people' to train 50,000 citizens every year on the use of smart city services Crowdsourcing and gamification are applied in Tianjin Binhai New Area to encourage the citizens' participation Nantong of Jiangshu Province has held application design competitions to collect smart city services Ningbo involved citizens' opinion in designing the smart city services

Fig. 7.1 Governance trends in EU and China pilot smart cities

Integrated management structures	While most cities rely on the coordination between existing departments, several EU pilot smart cities have implemented more integrated management structures that are intended to enable faster and more accountable decision-making. For example, Manchester leverages the 'Corridor Partnership', a ready-made structure for delivering the city's smart city programme[c]. Established in July 2007, Corridor Manchester recognised at its inception the importance of bringing world-class organisations together to work in partnership. The city council has the overall responsibility for successful delivery of the smart city programme, which is managed through the Corridor Partnership Barcelona City Council created a new department called Urban Habitat, under which several areas of the city are grouped: urban planning, ICT, energy, environment, urban services, infrastructure, etc. A coordination team, led by the Smart Cities' Director, is dedicated in finding synergies among the smart city projects; the team also ensures that the projects align with the long-term vision of the city All Chinese pilot smart cities have formal leadership structures with senior officials (e.g. Mayors, Vice Mayors, etc.) responsible for the overall delivery of the smart city programme; stakeholders are included in the smart city realisation. Some pilot cities have engaged smart city research institutes to provide consulting services
Benchmarking and key performance indicators (KPIs)	Most EU pilot smart cities have developed and publish KPIs. Some of the cities benchmark their KPIs against international standards. For example, Amsterdam has implemented a system to measure the economic, environmental, social and cultural outcomes from their smart city initiatives. Many of the smart city projects have a target reduction in CO2 emission, and the city tracks for each project the actual CO2 reduction against the target. The city measures the number of jobs created as a result of the smart city initiatives and has developed a method of estimating the financial return on investment on the smart city platform Barcelona is collaborating jointly with the city of Buenos Aires in the 'Smart City Index', a project developed by Professor Boyd Cohen, which publicises annual smart city rankings Pudong, Yangzhou, Yantai and Qianhai have established an evaluation system to measure their performance; social and economic analysis is required in all smart city projects in the pilot cities. The smart city evaluation system is under research by several institutes in China Pudong released the smart city KPI 1.0 and 2.0 in 2011 and 2012 KPI of Yangzhou introduced the international index, which included the global city competition index, global city index facilitate and green city index Qianhai established the standard assessment system, to evaluate the city management, public services, industry growth, environment protection, etc.

Fig. 7.1 (continued)

Open data infrastructure	All EU pilot smart cities have implemented open data infrastructure projects, which enable businesses and citizens' free access to city data. For example, Barcelona has implemented/is implementing several open data infrastructure projects, such as O-Government and efficiency, which is an open government project, based on the promotion of citizen participation, cooperation and transparency, especially making public data and infrastructures available Development of an Urban Platform for city management to unify data from various sources (this project will be ready in 2014), which includes the following projects: CityOS, Barcelona Sensors Platform and i-City Amsterdam, Barcelona and Manchester are participants of Open Cities[d], an EU-funded project which explores the implementation of open data engagement strategies in local government. The project provides a useful resource of best-practice examples and open data policy guidelines Data sharing and interconnection is one of the key tasks in China pilot cities; it is widely mentioned in all strategies and plans of each city In Beijing's Haidian district, traffic data is offered for use through APIs for commercial usage. Haidian has developed a public service platform to allow the data of different administrations to be shared, including housing information, business information, population information, elder healthcare information, etc. Nansha extended the definition of data management; the government built up a data store platform, where citizens can upload, download and use the data, and designed the business model for data exchange

[a]Serious games are simulations of real-world events or processes designed for the purpose of solving a problem.

[b]Commons4EU (www.commonsforeurope.net) is an EU-funded project (36 months, commencing November 2011).

[c]'Corridor Manchester' (www.corridormanchester.com) is the first partnership of its kind in the UK. It brings together Manchester City Council, the University of Manchester, Manchester Metropolitan University and the Central Manchester University Hospitals NHS Foundation Trust to build on the partners' investments in the 243 hectare area. The Corridor generates £3.2 billion, 25 % of the city's gross value added; 55,000 people work on the Corridor, 12 % of the city's workforce.

[d]Open Cities (www.opencities.net) aim to explore five main objectives: (1) Distil insights and best practices on how to apply Open Innovation in the public sector. (2) Gain understanding on the management of technological platforms in an Open Innovation context. (3) Validate the use of Pan-European Platforms for Crowdsourcing, open data, FTTH networks and Open Sensor Networks. (4) Trigger the development of Advanced Future Internet Services. (5) Understand how living labs could be effectively applied for promoting the adoption and cocreating of innovation in smart cities.

Fig. 7.1 (continued)

7.1.2 Challenges

In adopting an open governance approach, pilot smart cities face some challenges such as:

- *Engaging with a broad spectrum of stakeholders*
  Many of the pilot smart cities engage with a wide range of stakeholders in the development of their smart city plans, including citizen task groups, industry, technologists, academia, research institutes, social innovators, environmental groups, entrepreneurs and urban designers. However, none of the pilot smart cities appear to engage at an early stage with other important stakeholders such as retailers, financial institutions and investors. A smart city initiative created without the involvement of these key stakeholders may result in not receiving sufficient support and investment for the project.

  Another challenge for city leaders is to engage with both small-scale, informal communities and large-scale, formal institutions. In a recent article 'Three mistakes we're still making about Smart Cities',[1] Rick Robinson, a specialist in emerging technologies and smarter cities, notes:

  > *Challenges such as transport congestion, social mobility, responsible energy usage or small business growth are often extremely specific to local contexts. Successful change in those contexts is usually created when the people, community groups and businesses involved create, or co-create, initiatives to improve them.*

  It can be difficult for city leaders to communicate effectively with both large-scale institutions and small-scale communities; their cultures are different, they use different languages, and they are often focused on very different objectives.

- *Excluding segments of the population based on socio-economic factors*
  Many of the pilot smart cities engage with citizens via mobile applications (apps) that require access to smart devices. As a result, there is a risk that the needs of low-income individuals, less-educated groups, the elderly and others in need that do not have smart devices and/or do not know how to use them will be excluded. Smart city leaders will need to consider initiatives such as those implemented by 'Smart Seoul 2015', to increase access to smart devices and to educate new users on their operation. While a considerable number of citizens do not have access to such technologies, the provision of public services needs to be planned as a multichannel strategy, including offline provision in order to ensure equal access for all groups. This thwarts the potential efficiency gains smart city programmes can offer.

- *Further efforts to promote open data*
  Many of the pilot cities advocate data sharing and interconnection and open public data to private sectors. However, use of open data is still at a relatively early

[1] http://theurbantechnologist.com/2013/10/10/three-mistakes-were-still-making-about-smart-cities/?goback=%2Egde_4149893_member_5798251621112631297#%21.

stage of development for both EU and Chinese pilot cities. Furthermore, the law and rules for open data are evolving as well as the protection of the personal information and sensitive public data.

- *The assessment framework for smart city needs to be standardised*
  Most of the pilot cities in EU and China are trying to establish an assessment framework for a smart city. However, there is a lack of a standardised and widely applied assessment framework.

7.2 Financing

Financing remains one of the greatest challenges facing smart city initiatives within the post-financial crisis, risk-averse funding environment. Despite these difficulties, the pilot smart cities have raised funds to support their smart city development plans.

7.2.1 Key Trends

EU pilot smart cities have funded their projects through a combination of public (such as city council budgets) and private funding. Most EU pilot smart cities have established public-private partnerships to fund some of their projects. There are cases where private companies have contributed to project funding through provision of resources such as human capital, equipment, software, etc., rather than direct capital contribution.

Some EU pilot smart cities have received funding for specific projects from national governments. For example, Bristol received £3 million from the UK Technology Strategy Board in 2013 for a data integration project to create environmental and socially sustainable jobs.

Some EU pilot smart cities have received funding by participating in EU-funded smart city projects such as Commons4EU[116], Open Cities[118] and CitySDK.[2] Further funding will be available to European cities as the European Commission will invest circa €200 million over the next 2 years as a part of an action plan to make European cities smarter. Funding is mostly through the European Commission's Horizon 2020 research funds; the scheme will support the development of innovation zones and the establishment of new business models to drive data collection and data sharing between individual cities. Apart from these dedicated resources, there are further options to get support through other segments of the Horizon programme as well as through the European Cohesion Fund.

[2] CitySDK (www.citysdk.eu) is a 3.4 million Euro project, part funded by the European Commission. It is a Pilot Type B within the ICT Policy Support Programme of the Competitiveness and Framework Programme. It runs from January 2012-June 2014.

China pilot smart cities have also received funding for smart city projects from the central government, for example, NDRC, MOST and MIIT established some kind of specific fund to support the pilot application of smart city or allocated part of the funds from Mega project or some scientific and technological project to smart city applications. For example, Yangzhou, Wuxi and Chengdu received funding through the 863 smart city projects.

Most of the Chinese pilot smart cities fund their projects through public funding mainly at the local municipal level, although some cities have received funding from the provincial and national government. Some private funding has also played a role. Most pilot smart cities have or plan to establish local government financing vehicles (LGFVs). LGFVs enable a city to raise funds through bank loans, issuing bonds and equity market initial public offerings. Some of the pilot smart cities, e.g. Tianjin, Chengdu and Qianhai, have specifically targeted capital investment from foreign investors.

Furthermore, more channels are explored to fund the smart city project, such as PPP. Some pilot smart cities, like Yangzhou, Ningbo, Zhangzhou and Hengqin, are working to broaden the investment and financing channels and plan to gradually build up a smart city investment and financing model with government investment as the guidance, business investment as the main body, active support from financial institutions and broad participation of private capital.

7.2.2 Challenges

Some of the open challenges, with respect to financing the pilot smart cities' future development plans, include:

- *Communicating the value of their smart city projects to investors*
  To attract investment from the private sector, the pilot smart cities need to translate the benefits of their projects into the language that the private sector understands. For example, one benefit from a smart city project may be increased operational efficiency which improves the bottom line of the city council or the development of new services that generate incremental revenue streams for the city. In addition to demonstrating the value of the project, the private sector will also need to be convinced that the right business models are in place to ensure that they are able to generate a sufficient return on their investments. A city planning a smart city project needs to engage in a thorough cost-benefit analysis before approaching potential private sector investors.

- *Rising government debt*
  There are growing concerns over the rising level of local government debt, which may have an impact on the pilot smart cities' ability to finance their smart city projects.

  For example, in December 2013, the National Audit Office (NAO) in China published their audit results of 31 provincial-level governments, 391 cities and

over 33,000 townships, which showed an increase in the size and variety of China's local government debt since 2010.[3] Although the overall levels of debt appear manageable, some localities are overstretched. For example, the NAO found that three provincial governments, 99 cities, 195 county-level administrations and 3465 townships had direct debts exceeding 100 % of their annual economic output.

Concerns over local government debt are illustrated by the growing number of domestic rating agency downgrades of LGFV credit ratings. According to Nomura, in the first 9 months of 2013, there have been seven rating downgrades by different agencies, whereas this was a very rare occurrence before, suggesting that financial conditions have deteriorated rapidly and investors are increasingly worried. These downgrades will lead to higher financing costs, which may make it more difficult for Chinese smart cities to fund their smart city projects.

In Europe, the central government is by far the most important issuer of debt. Six of the countries hosting pilot smart cities have total debt to GDP ratios over 70 % (Italy, France, Germany, Netherlands, Spain and UK), and in the recent years, this has been on an upward trend. Local government debt is less than 20 % of the consolidated debt for most of the European countries. The exceptions are Germany and Estonia[4] where local debt exceeded 31 % and in Spain where local debt was at 22.6 %.[5] Even though these debt levels are lower compared to the Chinese counterparts, the local administrations are faced with very limited flexibility to increase their spending for the benefit of modernisation, as the increasing debt burden in most cases requires spending cuts by national laws.

7.3 Business Models

The key trends and challenges smart cities facing in developing innovative and sustainable business models to monetise their smart city development projects are described below.

7.3.1 Key Trends

- Most pilot smart cities have funded some of their smart city projects by forming public-private partnerships (PPP), where the long-term risk is transferred to the private sector. The PPPs are mainly structured as 'Build and Operate', 'Build Transfer and Operate' or 'Build and Transfer' models. Qianhai of Shenzhen

[3] The audit showed that China's local governments (and the investment vehicles they sponsor) owed 10.9 trillion yuan ($1.8 trillion) at the end of June 2013. They had also guaranteed several trillion yuan of debt explicitly and another 4.3 trillion yuan implicitly. Adding these three figures together yields a total of 17.9 trillion yuan or about a third of China's GDP (source: The Economist, January 4 2014).

[4] Total government debt in Estonia is 10 %.

[5] Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Structure_of_government_debt#Breakdown_by_subsector.

innovated the traditional PPP model where the government builds up a joint venture with the telecom operators to co-build and operate the infrastructure of the smart city and shares the risks and rewards.
- 'Cloud-based, pay-as-you-go' business models have been implemented by some pilot smart cities, such as Tianjin Binhai New Area.
- Some of the Chinese pilot smart cities such as Zhangzhou and Ningbo have established partnerships with telecom operators which provide value-added smart city services to citizens on a profit/cost sharing basis. In Zhangzhou, the users cooperated with telecom operators to co-invest in the smart city projects, and in return, the operators received revenue from the value-added telecom services.
- Venice has implemented a business model whereby the city collects revenues from other parties that use the municipal network infrastructure:
  - Public bodies such as universities use the municipal broadband network, and in return, the city collects a fee.
  - The citywide Wi-Fi network (www.cittadinanzadigitale.it) is available free of charge to citizens, and the money paid by tourists for the Wi-Fi service is used to maintain the network.

7.3.2 Challenges

Becoming a smart city is a process with no definitive end state. The pilot smart cities will require further funding to support their smart city development goals. Therefore, it is critical for city leaders to seek out new business and operating models that allow a city a continued and sustainable modernisation path, even after the first set of smart city goals has been achieved. Most of the 'more advanced' pilot smart cities recognise that this is a key challenge and are testing new business models in pilot projects to see if they will scale up for citywide implementation and for a duration beyond the allocated project stage. At least one pilot smart city, Bristol, has commissioned a study to assess different business models for commercialising smart city services and to identify the best business model(s) for the city.

The business models for the EU and China pilot smart cities still have great opportunities for further exploration. Different stakeholders including government, industries, business and citizens are involved in the smart city realisation and operation, so the right and duties of each stakeholder should be clearly defined and coordinated, thus to form a long-run mechanism.

7.4 Smart City Services

A summary of the smart services implemented by the pilot smart cities is provided below (Fig. 7.2).

Services related	% of pilot smart cities (Implementing the service[a])	
	China (%)	EU (%)
Crime/disaster prevention includes food safety	53	13
Education	13	27
Environment/energy	73	100
Health	20	20
Open data	7	100
Mapping/GIS	27	27
Public administration, mainly e-government	67	20
Support for businesses (SMEs)	13	–
Tourism	–	27
Transport	60	100

[a]Some of the pilot smart cities have implemented more than one application within a service category.

Fig. 7.2 Summary of smart services implemented by EU and China pilot smart cities

7.4.1 Key Trends

- Environmental/energy and transport applications are the most popular services implemented by the pilot smart cities. This is hardly surprising given that environment and transportation are the most frequently identified challenge areas for the pilot smart cities and that both the EU and China policy directions are focused in these two areas.
- A large number of Chinese pilot smart cities have implemented public administration projects as part of their smart services portfolio. Compared to EU pilot cities, most Chinese pilot cities include e-government or smart government as one of the elements of smart city.

  In contrast, a few EU pilot smart cities have mentioned public administration as part of their smart city offering. This is mainly because most EU administrations have started the implementation of e-government solutions and services a long time ago, and the use of electronic means of communication between citizens and governments (for information provision, or for conducting transactions) is well established. In 2013, 41 % of individuals already use online means to interact with the public sector, and some more advanced countries register up to 85 % of the citizens (Denmark) making use of online channels frequently to file tax declarations or apply for business licences, etc.[6]

  This indicates an important point in assessing smart city projects: the scope of activities/services that a city considers to be part of the smart city programme varies widely, which makes it all the more important to carefully analyse the

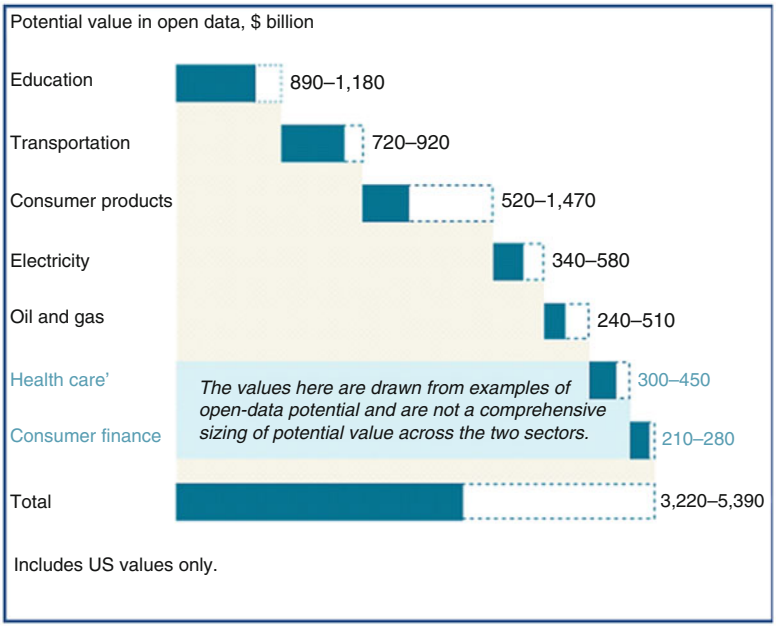
[6] http://www.west-info.eu/e-government-is-widespread-amongst-the-eu-population/4-18122013-bp-en/.

specific applications and services in order to create basis for cooperation and sharing of good practice.

- All EU pilot smart cities have implemented open data projects.[7] Investment in open data projects is likely to continue driven by:

  Activity and participation by EU cities in groups such as the Open Data Institute (www.theodi.org), an organisation which convenes world-class experts to collaborate, incubate, nurture and mentor new ideas and promote innovation and the Open Government Partnership (www.opengovpartnership.org) comprising of 62 countries that provides an international platform for domestic reformers committed to making their governments more open, accountable and responsive to citizens.

  The potential economic value that can be created by open data. According to a report by McKinsey 'Open data: Unlocking innovation and performance with liquid information',[8] seven sectors could generate more than US$ 3 trillion a year in additional value as a result of open data.



Source: McKinsey Global Institute analysis.

[7] In June 2013, the EU adopted new rules making public sector information available as an 'open data by default' system.

[8] The research for the report, published in October 2013, was jointly conducted by McKinsey's Business Technology Office, the McKinsey Global Institute and the public sector practice, which incorporates the McKinsey Centre for Government.

The Open Data Barometer (www.opendatabarometer.org), an organisation which aims to uncover the prevalence and impact of open data initiative around the world, issued a report[9] in October 2013 that ranks countries and regions in terms of readiness to secure the benefits of open data, actual levels of implementation and the impact of such initiatives. The study found that open government data policies have seen rapid diffusion over the last 5 years, reaching over 55 % of the countries surveyed in the barometer.

As can be seen in Fig. 7.3, all EU countries hosting pilot smart cities were ranked in the top 20 for open data readiness implementation and impact[10]; China was ranked 61st.

Although open government data policies have spread fast, the availability of truly open data remains low, and according to the report, no country can yet claim to be fully 'open by default'.

Some pilot smart cities have been nominated or received awards for their smart city services, for example:

- Nansha's smart public lighting management platform has won one international award (finalist in the Innovative Initiative Category at 2012 Barcelona Smart City Expo World Congress) and six domestic awards.
- In November 2013, Bristol won a green award in Amsterdam for its work improving energy efficiency through smart technology.
- The city of Amsterdam won first prize at the World Smart City Awards 2012 in Barcelona, with the open data program of DIVV.

Some of the 'more advanced' EU pilot smart cities have developed a large number of smart city applications. For example, more than 50 smart city services have been developed for the city of Amsterdam across five key functional areas: living, working, mobility, public facilities and open data. In Barcelona, there are over 100 projects considered to be part of the smart cities work in Barcelona. However, there are currently 13 projects that the city currently sees as a key part of the smart city plans,[11] as shown in Fig. 7.4.

Increasingly, cities in Europe are willing to collaborate and share their smart city applications with other cities. For example:

- Collaboration with other cities is a significant priority for Amsterdam and Barcelona in the development of ideas and networks, which they are facilitating through the City Protocol project www.cityprotocol.org.

[9] 'Open Data Barometer 2013 Global Report', Open Data Barometer provides a snapshot of OGD practices at national level. It also outlines a country-by-country ranking of 77 countries.

[10] Latvia, Croatia and Lithuania were not assessed.

[11] Source: BIS RESEARCH PAPER NO. 135; 'Global Innovators: International Case Studies on Smart Cities Smart Cities Study – Case Studies Report'; OCTOBER 2013.

Country	Rank	Readiness Sub-Index	Implementation Sub-Index	Impact Sub-Index	ODB Overall
United Kingdom	1	100.00	100.00	79.91	100.00
United States	2	96.26	86.67	100.00	93.38
Sweden	3	96.20	83.14	71.95	85.75
New Zealand	4	91.88	85.49	89.81	74.34
Norway	5	91.88	70.98	46.15	71.86
Denmark	5	83.54	70.20	55.73	71.78
Australia	7	87.88	64.71	51.19	67.68
Canada	8	79.11	63.92	51.59	65.87
Germany	9	74.50	63.14	53.81	65.01
France	10	79.39	64.31	39.07	63.92
Netherlands	10	85.92	67.06	21.42	63.66
Korea (Rep. of)	12	77.19	54.90	24.56	54.21
Iceland	13	62.99	52.94	26.45	51.01
Estonia	14	72.38	49.41	24.00	49.45
Finland	14	91.19	41.18	40.87	49.44
Japan	14	76.99	47.06	27.94	49.17
Spain	17	67.48	49.41	21.13	48.19
Austria	18	68.56	39.22	48.62	46.03
Israel	18	61.82	45.88	25.36	45.56
Italy	20	50.39	42.75	45.69	45.30
Russia	20	54.43	40.39	48.68	44.79
Switzerland	22	65.11	41.57	26.80	43.24
Czech Republic	22	61.83	40.00	35.36	43.18
Kenya	22	49.70	45.88	21.55	43.06
Mexico	25	49.10	45.49	8.37	40.30
Chile	25	65.79	39.22	18.27	40.11
Portugal	27	60.38	38.04	19.25	38.63
Brazil	28	66.03	32.16	27.87	36.83
Singapore	29	70.28	35.29	8.97	36.29
Ireland	29	61.81	32.55	23.92	35.76
Thailand	31	38.09	39.22	14.88	35.33
Argentina	31	46.08	36.47	17.29	35.00
Belgium	31	72.01	28.63	25.64	34.80
India	34	57.36	33.73	9.87	33.38
Uruguay	34	54.66	32.94	13.31	33.04
Costa Rica	36	47.34	35.29	0.00	31.21
Kazakhstan	37	34.96	32.16	2.84	27.61
Greece	37	43.95	27.84	12.30	27.59
Turkey	37	41.92	31.37	0.00	27.58
Morocco	40	36.46	27.84	16.59	27.24
Colombia	40	44.33	29.02	2.49	26.71
Hungary	42	32.42	28.63	10.51	26.09
Mauritius	42	35.71	30.59	0.00	26.08
United Arab Emirates	44	53.88	21.57	12.30	24.59
Rwanda	45	36.71	27.84	0.00	24.27
Jamaica	46	32.56	25.88	2.49	22.69
Philippines	47	40.33	21.18	10.31	21.91
Peru	47	36.36	23.14	4.95	21.74
Ghana	47	39.51	23.53	0.00	21.60
Ecuador	50	38.51	22.35	2.83	21.12
Tunisia	50	63.52	10.98	28.46	21.02
South Africa	52	35.39	18.43	10.31	19.20
Indonesia	52	34.91	20.39	0.00	18.66
Bahrain	54	42.94	18.04	0.00	18.18
Uganda	55	23.99	13.33	23.07	16.15
Botswana	55	12.16	21.57	0.00	16.08
Nepal	55	21.15	18.43	2.84	15.70
Tanzania	58	20.43	17.65	0.00	14.51
Malawi	59	28.24	11.76	16.52	14.47
Qatar	60	39.01	11.76	0.00	13.09
China	61	41.72	9.41	0.00	11.82
Venezuela	62	9.59	14.90	0.00	10.91
Pakistan	63	14.59	12.16	0.00	9.70
Jordan	63	30.95	9.63	0.00	9.63
Bangladesh	63	23.00	10.20	0.00	9.56
Ethiopia	66	15.45	10.59	0.00	8.70
Burkina Faso	67	17.63	9.24	0.00	7.35
Benin	67	11.60	9.41	0.00	7.28
Saudi Arabia	67	40.82	1.57	5.69	7.09
Namibia	67	11.57	9.02	0.00	7.00
Senegal	71	28.57	4.71	0.00	6.46
Cameroon	71	7.11	6.67	5.56	5.65
Zimbabwe	73	15.20	5.88	0.00	5.30
Yemen	73	0.00	8.24	0.00	4.69
Nigeria	75	36.90	0.00	0.00	4.35
Zambia	75	11.84	5.10	0.00	4.23
Mali	77	6.15	0.39	0.00	0.00
Grand Total		47.99	32.20	18.62	32.47

Fig. 7.3 Ranking of countries for open data readiness, implementation and impact (Source: Open Data Barometer 2013 Global Report)

Project type	Project
Transversal projects – projects involving many different departments	New telecommunications network: integration of different fibre-optic networks, boosting Wi-Fi network, reduced operating and maintenance costs and new business models Urban platform: Barcelona sensor platform, city operating system and apps and services Intelligent data: open data, measurement of city indicators and a central situation room for decision-making and control
Vertical projects	Lighting directorate plan: a strategic plan for lighting in Barcelona Self-sufficient islands: creating energy self-sufficient island, to improve practices related to consumption and production of energy Electric vehicles: development of electro-mobility in the coming years, short term (2 years) and medium term (5 years) in Barcelona Telemanagement of irrigation: remote management system for centralised control of the automated irrigation infrastructure in order to control the duration and frequency of irrigation in each area Orthogonal bus network or directorate mobility plan: orthogonal design of the bus network in Barcelona to improve urban mobility Urban transformation: within the frame of the remodelling of the main streets of Barcelona will develop a series of smart cities and telecommunications projects Citizen compromise to sustainability 2012–2022: a roadmap for achieving a more equitable, prosperous and self-sufficient Barcelona O-Government: implementation of open government, strategy and a roadmap, to develop tools and websites in specific areas of transparency, open data and civic participation Smart parking: network of sensors and displays of parking availability across the city Barcelona in your pocket: Barcelona contactless and mobile apps

Fig. 7.4 Smart city service projects – Barcelona

- Amsterdam, Barcelona and Manchester are partners in CitySDK (www.citysdk.eu).[12] CitySDK has developed an open-source infrastructure (open and interoperable digital service interfaces as well as processes, guidelines and usability standards) that enables a more efficient utilisation of the expertise and know-how of developer communities to be applied in city service development.
- Amsterdam and Barcelona (together with San Francisco) have signed an agreement to collaborate on establishing a common platform, Cityzenith 5D SMART City,[13] for using and sharing their data both within and between cities and their citizens via simple, mobile applications. 5D SMART City is the first and only cloud-based SaaS (software as a service) platform that consolidates multisource civic data in a single point of view.

[12] CitySDK is a 3.4 million Euro project, part funded by the European Commission. It is a Pilot Type B within the ICT Policy Support Programme of the Competitiveness and Framework Programme. It runs from January 2012–June 2014.

[13] www.cityzenith.com.

- Some EU pilot smart cities have participated in Apps for Europe (www.appsforeurope.eu), which is a support network that provides tools to transform ideas for data based apps into viable businesses and make these results sustainable and beneficial to the whole of the EU.
- Issy-les-Moulineaux has identified several applications in the area of education and intelligent buildings where it is of the opinion that the applications could be adapted and viable for other cities.

In addition, there is some collaboration between the EU and China with respect to smart city applications. For example, Climate-KIC,[14] the EU's main climate innovation initiative, signed a memorandum of understanding with the mayor of Tianjin in November 2013. The two partners will collaborate on projects that aim to boost green growth, such as programmes to retrofit buildings with energy-efficient technologies and initiatives to trial various 'smart city' systems.

7.4.2 Challenges

The key challenges the pilot smart cities are likely to face in the area of developing smart city services include:

- *Choice of smart city services and scale*
  There is no uniform smart service framework due to the development level, scale and base of informatisation in each city; therefore, it is difficult to determine the priority level in providing smart city services and to what extent the smart service will become a challenge.
- *Lack of a single customer*
  For many smart city services, there is no single customer, and application developers frequently need to involve many independent stakeholders, which makes it a very challenging task.
- *Open data creates new risks and challenges*
  Cities face several challenges in pursuing open data projects such as:
  - Supporting and equipping innovators and intermediaries to use data. The science of data mining has moved so much that things are possible now that many people are not aware of.
  - Low level of adopted standards for storing digital records, which can make it difficult for smaller tech firms to expand from city to city.
  - Ensuring there are clear rules for storing and controlling personal and confidential information.

[14] Climate – KIC is Europe's largest public-private Innovation Partnership focused on climate change (www.climate-kic.org).

7.5 Technology

Several technology trends and open challenges to generate innovative smart city services have been identified in the following areas:

- Broadband connectivity
- Internet of Things/Internet of Everything
- Smart personal devices
- Cloud computing
- Big data analytics

7.5.1 Broadband Connectivity

A high-capacity ubiquitous fixed (e.g. cable, xDSL, FTTx) and/or wireless (e.g. LTE, Wi-Fi, WiMaX) broadband network is a critical element of a smart city's ICT infrastructure. Unfortunately, broadband data at city level is very sparse.

Fixed and mobile broadband penetration rates together with the average speed of the fixed broadband network for countries where the pilot smart cities are located are provided in Fig. 7.5.

Country		Broadband penetration[a]		Average fixed broadband speed Mbps[b]
		Fixed (%)	Mobile (%)	
EU	Amsterdam, Netherlands	39.4	61.0	10.1
	Barcelona, Spain	24.3	53.2	5.9
	Bristol, UK	34.0	72.0	8.4
	Copenhagen, Denmark	38.2	87.5	8.1
	Florence, Italy	22.1	51.8	4.9
	Frankfurt, Germany	34.0	41.0	7.3
	Issy-les-Moulineaux, France	37.8	52.2	5.7
	Lyon, France	37.8	52.2	5.7
	Malmo, Sweden	32.2	101.3	8.4
	Manchester, UK	34.0	72.0	8.4
	Riga, Latvia	21.5	51.2	n/a
	Tallinn, Estonia	25.7	72.5	n/a
	Venice, Italy	22.1	51.8	4.9
	Vilnius, Lithuania	19.5	8.6	n/a
	Zagreb, Croatia	20.3	52.3	n/a
China		14.1	29.9	2.93

[a]Source: 'The State of Broadband 2013: Universalizing Broadband', a report by the Broadband Commission; September 2013.

[b]Source: 'The State of the Internet' Akamai Report; Q2 2013.

Fig. 7.5 Broad penetration rates for countries where the pilot smart cities are located

In most EU countries, with the exception of Germany and Lithuania, fixed or mobile penetration is above 50 %, and the average fixed broadband speed is 4.9 Mbps or above. Although there is minimal data at a city level within Europe, evidence suggests that city broadband penetration is much higher than at country level.[15]

In China, the fixed broadband subscriber reached 189 million, and the 3G mobile broadband user reached 401 million by the end of 2013; the penetration rate reached 14.1 % and 29.9 %.[16] The average speed of fixed broadband reached 2.93 Mbps; the fixed broadband speed of more than 2/3 of the Chinese pilot cities is above the average level.[17]

Broadband penetration in China is likely to increase. In 2013, China issued the 'Broadband China Strategy', which formulates broadband development targets for the country, and other measures were implemented such as the recent issuing of a first set of 4G mobile licences as well as the licencing of virtual mobile network operators.

Some EU pilot smart cities (Amsterdam, Barcelona, Manchester and Venice) and some Chinese pilot smart city (Haidian, Pudong, Nansha) offer free Wi-Fi to their citizens. Some EU pilot smart cities such as Manchester have made agreements and/or partnerships with third parties to provide the city Wi-Fi infrastructure.

7.5.2 Internet of Things/Internet of Everything

Most pilot smart cities have or are in the process of rolling out an overlay of ICT that connects things, organisations and people – the Internet of Everything (IoE) – to deliver services of public interest for its citizens. These services are built on the concepts of open data and open infrastructures, where municipal ICT assets and public data are made available across a municipal network.

Some examples of smart city services that have been deployed by the pilot smart cities using IoE sensing and communication technologies, such as radio frequency identification (RFID), wireless sensor networks, actuators, near-field communication (NFC), are provided below (Fig. 7.6).

Some pilot smart cities, as in Bristol's DEHEMS project, are testing the viability of IoT technology and assessing the benefits of the services before embarking on a full-scale implementation of the service.

Some of the challenges that may limit a city's investment in IoE technology and deployment of smart services include:

[15] For example, fixed broadband penetration in Barcelona is 30 % compared to 24 % at the country level.

[16] Source: MIIT website.

[17] Source: China Broadband speed report, first half of 2013. Issued by the Broadband Development Alliance.

Smart city service	Example
Education	*Issy-les-Moulineaux* has implemented several smart education services, which utilise the city's IoT infrastructure
Environment/energy	*Nansha* has utilised IoT sensing technology to renovate air conditioning systems in buildings. The impact of the project has reduced energy consumption by about 30 % *Pudong* has conducted energy auditing and sub-metering monitoring in 366 main public buildings by using industrial IoT gateways *Bristol* has leveraged the IoT for their Digital Environment Home Energy Management System (DEHEMS) to improve domestic energy efficiency (a pilot project deployed in 50 homes)
Transport	*Qianhai* has utilised an IoT platform and big data analysis technology to implement a smart parking solution in the city business district, which is the first of its kind in China *Manchester's* smart traffic solution Dynamic Road Network Efficiency and Travel Information System utilises the IoT technology to provide real-time information to travellers enabling them to make smarter choices with a greater degree of confidence on the reliability of services
Food safety	*Chengdu* has established a meat and vegetable traceability system by using an IoT platform

Fig. 7.6 Smart city services using IoT sensing and communication technologies

- *Some IP networks are not yet 'IoT/IoE ready'*
  City networks may be bandwidth constrained or the network may have limited resources such as power, memory and CPU processing to scale up to support thousands of millions of devices, or the network lacks sufficient IP addresses to accommodate the requirements of IoE applications. To overcome these challenges, further innovation and cooperation between standard bodies, technology vendors and network providers are required to develop an industry agnostic, distributed network architecture and protocols.

- *Lack of IoT/IoE skills and knowledge*
  Lack of skills and knowledge among municipal employees and city management is a major obstacle in using the IoT more extensively. To address these gaps, city councils will need to train staff and recruit IoT talent. Some cities are hiring consultants and third-party experts in order to build knowledge and identify successful IoE business models.

- *Lack of trust*
  IoT/IoE generates enormous amounts of data, and citizens may be concerned about their privacy and be unwilling to use the smart city services as they do not trust that the data is secured and protected.

- *Digital divide*
  Not all citizens may benefit from the IoT. For example, low-income individuals, the elderly and others in need that do not have access to the smart services and/or do not know how to use them.

7.5.3 *Smart Personal Devices*

Smartphones, tablets, etc., have considerable computing power and are capable of generating vast amounts of data that can contribute to generating smart city solutions.

As can be seen in Fig. 7.7, smartphone penetration in all EU counties where the pilot smart cities are located was over 30 % as at the second quarter of 2012. In China, smartphone penetration was at 40.8 %. Smartphone penetration is likely to be considerably higher in the pilot smart cities given that broadband penetration in the provinces where the pilot smart cities are located is higher than the national average and GDP/cap is also greater (see Chap. 5 for pilot smart city profiles).

In addition, smartphone penetration is likely to increase in both the EU and China pilot smart cities as smartphones become more affordable.[18]

Most pilot smart cities have developed smartphone applications for their citizens. The number of smartphone-related services is likely to increase significantly as smartphone penetration increases and city leaders get a better understanding of how these services can improve the lives of the citizens.

The types of smartphone-related services that influence satisfaction with the most positive and negative aspects of city life are provided in Fig. 7.8. The findings

Country		Smartphone penetration (country level)
EU	Amsterdam, Netherlands	54 %
	Barcelona, Spain	39 %
	Bristol, UK	56 %
	Copenhagen, Denmark	n/a
	Florence, Italy	31 %
	Frankfurt, Germany	30 %
	Issy-les-Moulineaux, France	41 %
	Lyon, France	41 %
	Malmo, Sweden	85 %
	Manchester, UK	56 %
	Riga, Latvia	n/a
	Tallinn, Estonia	n/a
	Venice, Italy	31 %
	Vilnius, Lithuania	n/a
	Zagreb, Croatia	n/a
China		40.8 %

[a]http://venturebeat.com/2012/12/03/mary-meeker-releases-stunning-data-on-the-state-of-the-internet/.

Fig. 7.7 Smartphone penetration for countries where the pilot smart cities are located (Source: Mary meeker, Morgan Stanley May 2012[a]; CATR in-depth observation 2014)

[18] According to research by IDC Average prices for smartphones in 2013 will be $372, down from $407 in 2012 and $443 in 2011. The average selling price for a smartphone could be as low as $309 in 2017.

Key finding	Description
Smartphone applications are rapidly changing city life	Mass demand for new ICT services has the potential to change city life beyond recognition in only 3 years
Services are expected soon	Smartphone owners expect that in just a year, market availability of the services tested by Ericsson will treble In 3 years, they believe that availability will be five times what it is today, turning the tested concepts into mass-market services
Applications will serve the majority of citizens	Almost 80 % of smartphone owners believe that mobile reservations, restaurant guides and same-day delivery services will be generally available to all citizens
The three aspects of life that city dwellers are most satisfied with are shopping, restaurants/cafes and leisure facilities	The smartphone service concepts that will enhance them were
	Shopping
	Same-day delivery online and in stores
	Mobile goods navigation
	A situational shopping recommender
	Restaurants/cafés
	Mobile menus and table reservations to preorder food
	Restaurant ingredient checker social restaurant guide
	Leisure facilities
	Mobile leisure reservations
	A virtual play connector
	Digital real-time trainer/assistant
The three aspects of life that city dwellers are least satisfied with are child day care/elderly care, authorities' communication and traffic	The smartphone service concepts that will enhance them were:
	Child day care/elderly care
	A connected food and medicine service
	A social care network
	An online near-care system
	Authorities' communication
	An online city service that makes public info available for smartphones and PCs
	A contextual mobile city service that provides location-based information
	24/7 online hotline city chat
	Traffic
	A personal navigator
	A self-driving/parking car
	A minimal day-travel scheduler
Apps to ease traffic are highly rated	20–30 % of respondents would use any of the new service concepts on a daily basis, with 40 % which would use traffic-related services every day

Fig. 7.8 Smartphone services that influence aspects of city life

are the results of an online survey of 7500 iPhone/Android smartphone users aged 15–69 in São Paulo, Beijing, New York, London and Tokyo conducted by Ericsson in October 2013.[19]

7.5.4 Cloud Computing

All pilot smart cities have deployed cloud computing to reduce the overall cost of providing services and/or deliver more responsive services for their citizens. Many of the EU pilot smart cities have significant experience. For example, Barcelona has implemented cloud-based solutions to deliver the following services[20]:

- *Identity, security and device management*
  This is an enhanced virtual desktop infrastructure (VDI) for field employees, which enables efficiency and greater productivity and higher productivity translates to better service to citizens.
- *Data centre and line-of-business platform*
  A range of applications have been developed such as Third Place (www.findthirdplace.com), which is a service to meet the needs of mobile workers, including information about places in the city where to work.
- *Big data and analytics*
  Open data BCN, Barcelona's open data portal, enables the city to offer its citizens a more open, accountable and efficient government, by using advanced analytics to transform the traditional information repository into service information in the cloud. The project includes a dashboard, called bigov Better City Indicators. The dashboard provides 120 key city indicators that, through Barcelona's work with the City Protocol Society, will become a benchmark for the city's level of development and how attractive the city is to live or develop a business in.

[19] Source: 'SMARTPHONES CHANGE CITIES: 18 services driving satisfaction with city life'; An Ericsson Consumer Insight Summary Report, October 2013.

[20] Source: Barcelona Realizes Vision of Innovative City Governance with Cloud, Devices, and Apps', Microsoft.

Source: 'Barcelona Realizes Vision of Innovative City Governance with Cloud, Devices, and Apps', Microsoft'.

- *CRM*
  Since the beginning of 2013, 16 line-of-business applications have been integrated in a new CRM system. The citizen care and engagement system records the history of interactions between citizens and government, including via social media, to identify segments and analyse them for common characteristics or experiences. This has led to awareness of the citizens who act as 'promoters' of the city, and this information is shared with all departments.

Two EU pilot smart cities, Manchester and Issy-les-Moulineaux, are partners in the European Platform for Intelligent Cities (EPIC)[21] project (www.epic-cities.eu). A key objective of EPIC is to develop a 'smart city in a box', to help make cities smarter for a fraction of the cost of traditional IT solutions. The project demonstrated the viability of using a cloud approach for the evaluation and delivery of smart city services, minimising hardware cost and providing elasticity to meet highly variable user demands.

A group of European and Japanese companies, research institutes, universities and cities are working together in the ClouT project (www.clout-project.eu) to deliver ways for cities to leverage the Internet of Things and cloud computing to become smart cities. ClouT, which stands for 'cloud of things', will develop infrastructure, services, tools and applications for municipalities and their various stakeholders to create, deploy and manage user-centric applications that capitalise on the latest advances in IoT and cloud computing.

Some of the Chinese pilot cities have made significant achievements in cloud computing. In Yangzhou, the Cloud Computing Centre has already integrated the data centres and the information systems of 59 organisations under the municipal

[21] EPIC is supported and partly funded by the European Commission.

government, and achieved the co-building and sharing of data centres' hardware, software, network platform, security guarantee and maintenance, and saved about 20 million RMB. Tianjin Binhai industrial cloud has been providing cloud services for more than 500 users including petroleum exploration, equipment manufacturing, satellite remote sensing processing, research institute and universities; the services include supercomputing, digital design, animation design, gene analysis, etc. Big Chinese Internet companies such as Baidu, Tencent and Alibaba have also built up very strong cloud computing services.

Although cloud computing is being used across the pilot smart cities, there are a number of obstacles and challenges that inhibit cloud adoption, including:

- *Security*
  Security is the top inhibitor of cloud adoption. City leaders need assurance that cloud service providers understand and appropriately manage the security risks associated with storing their data and running their applications on cloud systems. However, there are signs that security issues are declining. In 'North Bridge Venture Partners third annual Future of Cloud Computing Survey',[22] though still the top inhibitor, security is declining year-on-year from 55 % of respondents in 2012 to 46 % in 2013.
- *Complexity of managing cloud components*
  The increasing array of cloud standards together with the relative immaturity of cloud computing makes it more complex for IT departments to implement cloud solutions.
- *Privacy*
  City leaders and citizens need be confident that information stored in the cloud, wherever in the world, will not be used or disclosed by the cloud provider in unexpected ways. Modern privacy laws such as Personal Data Protection Laws and implementation structures are required as they provide citizens with confidence that their data will not be used or disclosed in unexpected and undesired ways.
- *Interoperability between clouds and vendor lock-in*
  Some cities may hold back on full cloud computing adoption until they're convinced that they can move their data off of a given cloud and between clouds (such as public and private clouds).

7.5.5 Big Data Analytics

Advances in computing and analytics have enabled the pilot smart cities to transform the vast amounts of data generated from various sources into new applications to improve productivity and services for citizens. For example, Ningbo and Qianhai have

[22] Source: http://www.nbvp.com/2013-cloud-computing-survey.
(www.placr.co.uk)

conducted data mining of big data to improve planning of urban transport systems and reduce pollution. Nantong's population, legal persons, geospatial and macroeconomic underlying databases have been built, to realise data sharing and cross-sectorial applications. Barcelona has used advanced analytics to develop its 'bigov Better City Indicators'. Manchester has utilised big data analytics to better understand the connection between people and place and the epidemiology of 'troubled families'.

Most pilot smart city applications created using big data analytics have been developed by the city's own resources and are targeting government/city services with the goal of identifying trends and/or refining operations. However, there are several examples of third-party developers in the EU that are generating value for the public by applying advanced data analytics to open city/government data. For example, Placr (www.placr.co.uk), a privately owned UK company, has developed applications which utilise various sources of public transport data to reduce the costs and improve quality of transport in the UK.

There are some challenges to overcome for cities to capture the full potential of big data, including:

- *Shortage of talent*
  To realise the value from big data, cities will need to hire people with skills in data analytics and also people who are able to use the insights from big data. There is a great demand for people with these skills including commercial organisations and financial institutions that are able to attract talent with lucrative compensation packages.
- *Data policies on privacy and security*
  Privacy and security is fundamental to the city's trust relationships with its citizens. City leaders will need to ensure that big data analytic policies are implemented and comply with privacy laws and government regulations.
- *Technology*
  New technologies will need to be deployed to capture, store, secure, search, share and analyse the data. The range of technology challenges will differ from city to city depending on the capabilities within the organisation but may include the following:
  - Security issues such as identity and privacy management, where, for example, pseudo nomination must be applied throughout the whole system in order to separate the data collected about a user from the user's real identity
  - Handling the increasing complexity of managing distributed systems
  - Integrating data from legacy systems and incompatible standards and formats

7.6 Government Policies

Several government policies have been or are in the process of being implemented that support the development of smart city solutions, applications and the implementation of those in pilot cities. In the EU, because of the considerable

independence of cities from central government policy measures and a large degree of fiscal independence in particular, most of these policy measures have the character of coordination, showcasing good practice and providing incentives. There are policy frameworks and legal measures in place in some areas that directly determine the cities' possible development paths. These are mainly in the area of environmental regulations for new construction, however, and only indirectly affect possible smart city projects.

For China, there is a stronger involvement from central government level through MIIT, NDRC, MOST or MOHURD opinions and guidelines, in particular, themselves guided by the 12th Five-Year Plan and the dedicated Five-Year Plans for the Development of the Information Security Industry, for the Development of Internet of Things, for the Development of e-commerce and most specific for Smart City Development. Still, central government's main role is to provide guidance and to facilitate the development and implementation of smart city projects for those cities that are willing to engage in this kind of modernisation. Given the number of Chinese cities and the required financial effort to modernise their administration and management, the Chinese cities are facing no less of a challenge to find new forms of financing the investment despite the considerable resources in particular provided by the China Development Bank.

Examples of recent government policies are provided in Fig. 7.9.

7.6.1 Challenges

Government policies play a twofold role in promoting smart city development as a tool to achieve more sustainable living conditions.

Alleviate financial burden

Because of the vast financial effort required to modernise cities to meet the needs of a sustainable and energy-efficient growth path, government action is required to help the cities ease the financial burden and create incentives for such modernisation. This can be achieved by:

- Direct financial contributions from the central government through R&D funds and dedicated support schemes for developing and implementing solutions.
- Making it easier for private sector involvement: Government policy can also be used to create a favourable environment for private sector involvement. This can be by providing a reliable legal framework for establishing public-private forms of cooperation, including preparation of incentivized standard contracts and reference business models. An important policy consideration is to what degree direct public sector investment in private infrastructure, e.g. telecommunications networks, should be allowed – a consideration especially for the EU – where state aid rules limit governments' involvement in such markets in principle.

Policy area	Example
R&D funding	The EU Commission intends to make available approximately EUR 200 million for smart cities and communities in the 2014–2015 budgets of the Horizon 2020 research and innovation programme, to accelerate progress and enlarge the scale of rollout of smart cities solutions. These R&D resources can be combined with funding from the European Cohesion Funds, aimed at smart, sustainable and inclusive growth[a] On a national level, the UK has included the Internet of Things and smart cities as two of the five strands, alongside of cloud computing, e-commerce and dig data, in its digital economy Strategy[b] Ministry of Science and Technology has initiated smart city R&D projects under the 863 programme; the present phase is during 2012–2015, involved eight fields of smart city basic technologies, and the total fund is about 50 million RMB[c]
Funding for demonstration projects	On the EU level, the European Innovation Partnership for Smart Cities and Communities (EIP-SCC) has allocated a total of EUR 365 million for the development and implementation of demonstration projects for smart cities in the area of energy, transport and ICT As one of the very few member state governments establishing a dedicated system of financially supporting the development of smart city solutions, in October 2013, the UK Government announced funding of £24 million by the Technology Strategy Board to showcase how cities can grow their local economy and improve the lives of their citizens by using new technologies to integrate and connect city systems[d] The German Government has included the aim of promoting smart services in their recently agreed coalition agreement, with the aim of creating a competitive environment for private sector development of such services and the utilisation of smart solutions in public and private sector MIIT and Ministry of Finance have established the IoT specific fund in 2011 to support the pilot applications; the total funding reached 1.5 billion RMB by 2013. NDRC has established about 30 IoT pilot projects since 2011 Through the definition of 'Smart City Pilot Cities', MOHURD has managed to establish a large group of cities that are formally engaging in smart city pilot projects in cooperation with the China Development Bank
Environmental policy framework	The Europe 2020 strategy for smart, sustainable and inclusive growth and the initiative 'Resource-Efficient Europe' are providing the guiding framework for (among other) city development in the EU. This reflects the commitment of the EU-15 member states under the Kyoto Protocol and later additions by the new member states. The EU as a whole has committed itself to the emission target reduction, and the member states have submitted respective commitments to ensure that these targets can be met[e] Environment protection is one of the key application areas for most of the Chinese smart city. The areas include water resource management, environment monitoring, pollution emission monitoring, hazard materials monitoring and safety manufacturing, etc.

Fig. 7.9 EU and China government policies on smart city development

Infrastructure development	In its most recent reform effort, the EU Commission has proposed a reform package for the electronic communications markets that seeks to ensure high-quality, high-speed and affordable broadband connectivity for all EU member states. Through new market definitions, reduction of roaming fees and the prospect of trans-national licencing regimes, market efficiency is intended to be increased, and incentives for network operators to upgrade their networks are provided. Each member state has formulated a national broadband plan, defining bandwidth and penetration targets up until 2020, with the EU Digital Agenda Scoreboard providing constant assessment of the level of achievements With similar thrust, the Chinese central government has published the 'National Broadband China Strategy and the Implementation Scheme', formulating penetration and bandwidth targets until 2020, and has also accelerated the process of introducing more competitive elements in the telecommunications markets, such as MVNO licences, 4G licences and the licencing of China Mobile as a new fixed broadband provider, in order to ensure faster deployment of high-quality infrastructure
Open data	In order to make the use of government data by private sector actors more smooth and efficient, the EU Commission has suggested an 'open data by default' policy that would make the public availability of government data in machine-readable format. Currently, there is a wide variety of open data policies and legal frameworks, with the member states and municipalities mostly being independently responsible for the dissemination of this data. Parallel efforts across the EU are underway to find efficient solutions to create economically beneficial open data portals and applications Guidelines on open data currently are mainly developed and driven by nongovernmental initiatives. See the examples on the Civic Commons website (http://wiki.civiccommons.org/Open_Data_Guidelines) or on the Open Commons Foundation's 'Open Data Handbook' pages (www.opendatahandbook.org/) While there are several efforts underway to make Chinese Government data on central and city level more accessible to citizens and entrepreneurs, currently, these efforts are not under the umbrella of a joint policy following common standards
Support entrepreneurship and ICT skills	In an effort to promote IT entrepreneurship and encourage new innovative market entrants, the EU Commission has partnered with relevant companies to depend the 'Grand Coalition for Digital Jobs'. The aim is to create 100,000 additional traineeships until 2015, to improve students' ICT skills by modernising education and training schemes and to promote ICT-related jobs through corporate marketing systems[f] In China, there are similar efforts conducted by the pilot cities. Many of pilot cities conducted training programme and competitions to increase the ICT skills of the citizens and the entrepreneurs, such as Pudong, Ningbo, Yangzhou, etc.

[a]Source: http://europa.eu/rapid/press-release_IP-13-1159_en.htm.
[b]Source: http://bit.ly/19fPKeX.
[c]Source:http://www.863.gov.cn/.
[d]Source: http://bit.ly/1kmZc2c.
[e]For details: http://ec.europa.eu/clima/policies/g-gas/index_en.htm.
[f]https://ec.europa.eu/digital-agenda/en/grand-coalition-digital-jobs-0.

Fig. 7.9 (continued)

Regulatory framework

At the same time, there is the need for a regulatory framework ensuring that technologies are used efficiently and safely:

- Sound analysis of the use of standardised applications and interfaces, e.g. with respect to utilisation of open-source software as opposed to proprietary software solutions, allowing for better cooperation between smart city projects and higher transferability of good practice.
- Clear standards for data storage and publication principles and formats, for more convenience of use of such data across government departments as well as by private sector entrepreneurs.
- Policies to actively promote private sector involvement in developing smart city-related solutions, e.g. through entrepreneurs' workshops, hackathons, competitions, etc.
- Legal framework to safeguard network and application integrity, citizen privacy and enterprise businesses is required to establish trust in the system and promote uptake of smart city applications despite concerns about excessive data collection (e.g. smart metering systems).
- Information security policy is required to ensure the implementation of the security legal and regulatory framework and also on the behavioural and technological level. This needs to cover a wide range of issues from data storage redundancy to separation of user information from usage data, network and data usage policies for government employees and much more.

Chapter 8
Recommendations

As has been shown in this report, the concept of smart city means very different things to different cities. From the implementation of individual traffic or waste management, solutions to the integration of citywide services through the use of ICT come under the umbrella of 'smart city'. This is natural, as each pilot city comes from a different starting point, with a different set of social and economic preconditions, natural and geographical settings, economic structures, experience with technological solutions, maturity of infrastructure, etc. Consequently, there cannot be a single set of recommendations on how to 'get smarter' that would fit all or just a majority of the pilot smart cities.

There is, however, a case for making procedural recommendations that should support all pilot smart cities participating in the EU-China cooperation project, or indeed any other smart city. Becoming a smart city is a process with no definitive end state; a city must continuously improve in terms of both providing better services to the citizens and enterprises and utilising its resources more efficiently. The recommended that roadmap for continuous improvement is for the pilot smart cities to advance step by step until reaching the 'state-of-the-art' level of maturity and is illustrated below (Fig. 8.1).

The 'smart city staircase roadmap towards maturity' recognises that some pilot smart cities may have no interest or do not have sufficient resources to achieve the highest possible level of smart city maturity for a given characteristic, for example, 'strategy' or 'business models'. Instead, it provides guidance on how to address the task of continuous modernisation step by step and keeping a balance of ambitious, achievable targets without putting the city system under excessive pressure. The 'smart city staircase roadmap towards maturity' has two important underlying principles:

- *No leapfrogging*
  Leapfrogging from a 'basic' level to 'state-of-the-art' level of maturity is not only an impossible task for most pilot smart cities in terms of managerial, technological and financial capacity but in most cases will also be counterproductive.

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_8

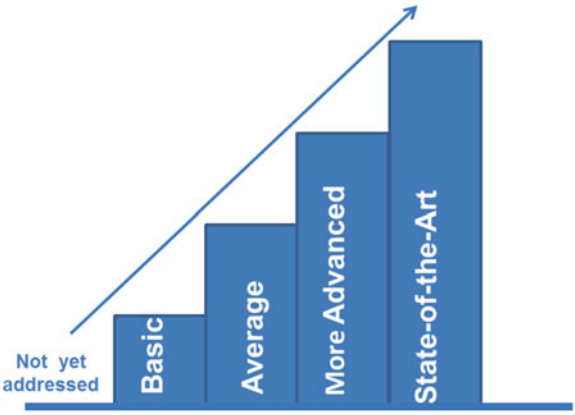


Fig. 8.1 The smart city staircase roadmap towards maturity

Embarking on such a strategy is likely to exert so much pressure on many city systems and functions that normal day to day operations will tend to suffer. Capacity, such as human resources, will require training; new ICT systems may need to be implemented and tested; and the impact of the change needs to be approved by relevant stakeholders before approaching the next challenging task.

- *No isolated advances*
  Advancing one characteristic of the assessment framework while neglecting to advance others will in most cases be counterproductive. For instance, it is hard to imagine how a smart city can manage to achieve 'state-of-the-art' level of maturity in 'ICT infrastructure', if it does not at the same time move ahead in areas of 'governance', 'finance', 'business models' or 'stakeholders'. An isolated focus on ICT infrastructure may lead to new infrastructure being in place, but if the ICT infrastructure fails to meet the needs of the citizens and enterprises, it will remain unused and the investment wasted. However, not all characteristics need to be perfectly aligned to achieve the same level of smart city maturity. It will be the responsibility of the city government and its citizens to decide the priority areas for their city. However, a large discrepancy between levels should be avoided as this is an indicator that the city has not achieved sufficient capacity to move ahead in its modernisation course.

In order to advance on the 'smart city staircase roadmap towards maturity', pilot smart cities have access to several resources, for example:

- Knowledge-exchange platforms such as those established between the EU and China
- Case examples of smart cities documented in this report

Although an assessment of the pilot smart cities level of maturity is provided in Chap. 6, it is highly recommended that each pilot city conducts a critical assessment of its current maturity level. Once this assessment has been completed, the pilot smart city should then identify other pilot smart cities or individual projects within

a city that have a strong similarity to the next step that needs to be taken on their 'smart city staircase roadmap towards maturity'.

As a guide, some generalised recommendations for each characteristic of the Smart City Assessment Framework are provided below.

8.1 Smart City Strategy

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Smart city vision clearly articulated and related to overall city vision Limited strategic focus on ICT	Smart city vision contains objectives for at least some of the following factors: environment, energy, transport, waste management, urban-rural cohesion, quality of life Limited smart city key performance indicators (KPIs) ICT plan in place	Clearly defined and measurable smart city KPIs ICT vision for the city	Smart city KPIs benchmarked against international standards, which are made available to all stakeholders ICT plans ensure major technology trends which are included in their city planning

8.1.1 Integrated City Planning

The ultimate goal is to align the smart city strategy with the overall strategy of the city and region. A separate smart city strategy that stands in isolation is unable to take into consideration the requirements of the city management, citizens and other stakeholders. In particular, there is a danger that the smart city becomes a technology project rather than a project of improving the livelihood of the city.

8.1.2 Looking Beyond the Horizon

The objective of formulating a smart city strategy should not focus on simply meeting the next achievable steps. Instead, the goal should be to dedicate sufficient resources to systematically screen national and global 'good' practice to identify the most advanced solutions. This know-how will enable strategic choices to be made that are as far as possible future-proof with respect to:

- Choice of technology standards, for example, the emergence of IoT
- Consideration of user behaviour such as the rise in mobile bandwidth demand
- Future population trends, for example, gentrification

This approach should also help to avoid making strategic choices that appear sensible today but will be outdated in a few years resulting in frequent major and costly adjustments.

8.1.3 Modern Management Tools

A sophisticated state-of-the-art smart city strategic development plan requires equally sophisticated methods to implement this plan. While this requires capacity building in a wide number of areas, a key component is a system that allows decision-makers to assess the success, or lack of it, against the plan. To this end, relevant KPIs should be established that enable continuous assessment of the plan's progress and provide early alerts when implementation challenges arise. Some of the pilot smart cities have already implemented KPIs to measure their performance in meeting the smart city objectives, and in a few cases, pilot cities have benchmarked their KPIs against international standards. These provide good case examples for those pilot cities that are less advanced in implementing their smart city strategic development plans.

Cities can also benefit by conducting urban simulation and scenario planning models as these tools can help to better understand the impacts of policies and implementation strategies under different context conditions.

8.2 Stakeholders

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Stakeholder roles and relationships clearly defined but *no* citizen engagement in the design of service	Stakeholder roles and relationships clearly defined with limited citizen engagement in the design of service	Stakeholder roles and relationships clearly defined Citizen engagement in the design of service, e.g. feedback loops established	Uses multiple forms of interactive technologies to engage with citizens, e.g. crowdsourcing, gamification, etc., as mechanisms to engage with citizens Actively promotes and publicises smart city developments to stakeholders Provides training to help citizens adopt new services

8.2.1 Active Customer Engagement

At the heart of advancing the 'smart city staircase roadmap towards maturity' is the notion that one of the cities' major stakeholders is its customers and that these customers have needs and preferences. Each customer type is likely to have different requirements. For example, enterprises may value efficient procedures for engaging

with government, healthy and well-trained employees, low energy costs, etc., whereas citizens' requirements may be focused on efficient and affordable public transport, clean air and water and access to health and education services. Actively seeking the needs and assessing the requirements of all customers, including the needs of groups that may struggle to voice their needs themselves, such as ill-educated groups and economically or socially disadvantaged groups, are a challenging task for any city. Some of the pilot cities have implemented multiple forms of interactive technologies to engage with citizens as mechanisms to engage with their customers and may offer those pilot cities that to date had limited engagement with their customers some practical advice and ideas on how to address this critical issue.

Customer engagement is a continuous process and is not limited to the planning stage as there is most likely always room for improvement. Cities striving to reach state-of-the-art engagement with their stakeholders should continuously seek new ways of better serving their customers.

8.2.2 Seek Feedback and Opinions of Employees

The process of developing and implementing a smart city strategy requires skilled and experienced human resources, and it is crucial to seek the views of existing employees across all departments. This group has vast experience with the city's processes and challenges and can provide valuable input as to which solutions and services provide benefits. Implementing smart city solutions often requires new technology and may require capacity building including recruiting new people, and this may make current employees feel threatened about their future role and influence in the city system. Involving employees early in the process creates a better atmosphere of jointly working on the next iteration of the city's development and provides every employee the opportunity to contribute and have ownership in delivering the result.

8.3 Governance

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Departmental governance structures	Cross departmental governance structure is in place to ensure collaboration across the city planning development process	Citywide governance structures with shared performance targets across departments	Citywide governance structures with shared performance targets across departments Processes in place to Allow stakeholders to participate in decision-making Ensure there is transparency and accountability of the various stakeholders

8.3.1 Align Organisational Structure with Smart City Vision

The key requirement with respect to a successful governance structure is to create an integrated system of governance that on the one hand allows each department to focus on its respective specialist task and on the other hand to ensure that all city functions and hence departments become part of the city modernisation process under the 'smart city' headline. While each city may find a different solution for itself that works best under the given circumstances, something all cities should consider is to learn from modern private sector enterprises how best to create matrix organisational structures that allow for functions such as ICT to facilitate the work of the line departments and inject modernisation elements where appropriate.

8.3.2 Public Participation

Related to 'stakeholder engagement' recommendations, the city governance in general and the smart city governance in particular should develop ways to practically involve stakeholder opinions in their decision-making process. Major city-level decisions such as new traffic solutions or waste disposal schemes are typical examples where public consultation processes yield better, i.e. more efficient and effective results than city governments designing, developing and implementing solutions in isolation. Deciding the areas of city governance that should be subject to large-scale consultation and those areas which require a more limited involvement from expert circles should be clearly formulated by the city government and communicated to all stakeholders. In this context, it is also relevant to develop a strategy for disseminating public sector information, for example, through open government or open data portals, as this enables stakeholders to form opinions and make substantial contributions to the decision-making process.

8.4 Funding

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Funding for pilot project but no plan to expand funding beyond the pilot Basic monitoring of financial expenditure	Plans in place for raising funds to expand some pilot projects to full-scale rollout	Funding available to expand pilot to full-scale project Well-established system to monitor financial expenditure	No funding issues and funding available to meet al*l* smart city objectives

8.4.1 Develop a Sustainable Funding Plan

Securing funding for pilot applications or services is the first and often necessary step towards a city achieving sound and sustainable funding for its smart city strategic goals and objectives. A city seeking to engage in a systematic and long-term process towards modernisation and smart city maturity should from the outset evaluate the range of financial options to ensure there is sufficient funding to deliver its smart city objectives.

Pilot smart cities that have been successful in funding their smart city projects are skilled in communicating the value of their projects to investors in the language they understand. For example, the private sector values projects that drive shareholder value and maximise profits, whereas local or national government projects tend to be focused on delivering high-quality services to citizens and improving operational efficiencies.

Pilot smart cities facing funding issues may find it useful to explore some of the financial instruments such as green bonds, Energy-Saving Performance Contracts, crowd funding, etc., that have been used successfully by smart cities globally (case examples are provided in Sect. 2.2.2).

8.4.2 Scenario Planning

While state-of-the-art applications and services are usually in the interest of all cities and communities, not every city will be in a position to establish structures and partnerships that allow them to achieve this during their planning period. Developing various scenarios that describe the modernisation path for various funding requirements is advisable. As the success of seeking funding is not always predictable, it is beneficial to have a specifically described 'Plan B' in place in the event that only limited resources are available for the project. If funding for the first best option does not materialise during the planning process, this enables the project to continue in its revised form, whereas the lack of alternative planning forces ad hoc improvisation or cancellation of the project.

8.5 Value Assessment

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Smart city business case assessed on an individual project basis and considers only financial considerations	Some nonfinancial value assessed as part of the business case	The city has established a smart city evaluation framework, which includes some nonfinancial factors (e.g. social, environmental)	The assessment evaluates the *overall* impact (economic, environmental, social and cultural outcomes) of all smart city projects

8.5.1 Rational Planning and Analysis Tools

A sound value assessment is based on defining the metrics that directly relate to the city's goals and targets and then tracking progress against the targets. Some of the indicators are relatively easy to quantify such as 'private cars on the road at peak time' or 'carbon emission per year'. However, other factors that are less quantifiable should also be assessed, for example, 'citizens' perceived security' or 'attractiveness to investors'.

The more advanced pilot smart cities have developed planning systems and analytical tools that enable management to track a comprehensive range of metrics and make considered choices about smart city-related projects and improvements, which could provide useful learning for pilot cities which currently do not have this capability.

8.5.2 Utilise Private Sector Know-How

Developing a value assessment process in partnership with private sector organisations has considerable merit for city governments as these tools are widely used in private sector projects. A private sector partner could be a consultancy firm with expertise in value assessment tools; the consultants can provide additional expertise for the city government in terms of assisting in decision-making and also build government capacity in the process. An alternative approach, advisable for cases where the city government has established a public-private partnership (PPP) for the delivery of the smart city project, is to develop a value assessment system with the private sector partner. This has some advantages as at an early stage, both partners will need to agree on the financial and nonfinancial outcomes of the project before it commences. In addition, the process should assist in the negotiation and agreement of PPP contracts.

8.6 Business Models

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Business models are unlikely to be sustainable beyond the pilot phase	Exploring a variety of different business models for pilot projects (some proven and others in the experimental stage)	Business models are likely to be scalable beyond the pilot phase (may not yet be proven)	Uses a variety of business models that have been implemented for full-scale projects

8.6.1 Allow for Creativity

There are no limits with respect to the range and variety of business models that can be used to deliver smart city services. Some business models are tried and tested such as outsourcing non-critical or profitable services to a private operator or revenue sharing models. The more advanced smart cities have taken the opportunity to test new business models in pilot projects in order to assess scalability for full project implementation.

Business models should be flexible to include incentives that support the overall goals of the city, as smart city projects are not solely focused on service provision and may also include other objectives such as providing incentives for change of behaviour. For example, the project may provide benefits for citizens participating in traffic telemetry trials, tax relief for early adopters of online tax declarations or similar. It is important for city governments to understand where value is created, who benefits and how to communicate value to different stakeholders for each project, as this contributes to the overall success of a city's modernisation strategy.

8.6.2 Clearly Define Business Model Parameters

As many smart city projects involve private sector partners, the city government must balance the benefits and risks of outsourcing all or part of the service to a third party. A clear definition of the roles, responsibilities and deliverables of the various parties is required, which need to be underpinned by robust contracts. In addition, the city government should conduct a thorough due diligence of all partners to minimise any downside risk of the third party failing to meet their contractual obligations.

8.7 ICT Infrastructure

Level of maturity			
Basic	Average	More advanced	State-of-the-art
Broadband (fixed, mobile or converged) network converge for all pilot projects ICT infrastructure provided for each project	Targeted ICT project investments (e.g. smart grid) Some of the ICT infrastructure is managed or shared across smart city projects	100 % citywide broadband coverage ICT infrastructure managed or shared across all smart city projects Funding for advanced broadband network (e.g. LTE, vehicular wireless network, sensors, etc.) and implementation of citywide data centres for future smart city projects	100 % high-speed (>20 Mbs) broadband coverage Real-time city operations are optimised ICT vision and strategy overseen by dedicated City CIO Measures in place to ensure that the city 'future-proofs' its investment in ICT infrastructure

8.7.1 Technology-Neutral Infrastructure Targets

The technology infrastructure required to deliver smart city projects should be defined by function rather than in terms of a specific technology. For example, roll-out targets for broadband infrastructure would include parameters such as the network speed, coverage, service quality, penetration rates, timeline, etc., with the technology choice (e.g. LTE, FTTx, etc.) left open to meet the functional parameters.

8.7.2 Strategic Focus

City governments need to understand the long-term view of their smart city investments, which can be quite difficult to achieve when very often ICT is used on a project-by-project basis. Appointing a chief information officer (CIO), who understands the strategic implications of ICT for the city as well as the city's objectives, can help overcome this issue as he or she can assist in the decision-making process of prioritising investments.

8.7.3 Open Standards and Open Data

Application and technology standards should where feasible be based on open standards as they facilitate cities to collaborate with each other and with the private sector. For example, collaboration in the development of smart city services via open Application Programming Interfaces (APIs) and other standards enables cities to take full advantage of the economies of scale of using these widely adopted standards.

The European Innovation Partnership in cooperation with the European Standardisation Organisations (CEN, CENELEC, ETSI, etc.) as well as various standard bodies in China such as the China National IT Standardisation TC (NITS) plays an important role in identifying who is already active in developing standards on these topics and coordinating ongoing smart city standard work.

More and more cities are opening up their databases to the public in order to encourage the reuse of the data stored in them so that businesses and individuals can create value out of the data, both for themselves and for the public. To date, there is very little evidence of standardisation of government data, with the exception of public transport data, where many data publishers were making use of the General Transit Feed Specification (GTFS). Given the potential value in being able to combine statistics, financial information and company information across city and country borders in order to address key social issues, cities should work on developing the inclusive and open standards needed in the future.

8.7.4 Policy Framework Facilitating Modernisation

Given the high cost of ICT infrastructure investment, the policy framework should allow flexible designs of public-private partnership, where applicable, to cofinance infrastructure upgrades that are commercially not yet viable. This should be linked to strict obligations regarding the impact of such projects, in order to ensure efficient use of public funds. However, a city should have sufficient flexibility to be able to prioritise its operations in such a way that it has the ability to implement, for example, a quick rollout of metering systems to provide innovative public services. At the same time, the policy framework should cover all stakeholder interests, including consumer protection and citizen privacy interests, in order to create trust in the new applications and speed up their adoption.

8.8 Smart City Services

Level of maturity			
Basic	Average	More advanced	State-of-the-art
A few (<5) smart city services – some are pilot projects	Implemented several smart city services but some may still be pilot projects	A wide range of smart city services meeting the needs of a cross section of stakeholders Services have been implemented citywide	Several of the smart city services represent 'best practice' and have received awards for their services Smart city services are delivered through open data and crowdsourcing initiatives

8.8.1 Prioritise Services

City government decision-makers will always be faced with the challenge of selecting from among the hundreds of possible smart city applications those that provide the most value in meeting the city's objectives. This means decision-makers will need to use analytical tools to compare the value of potentially unrelated projects in order to decide which ones to select.

8.8.2 Create Service Platforms

In order to create synergies in terms of technology infrastructure and capacity building within the city administration, it is advisable to create structures early on which enable a range of services to be hosted on a common platform, for example,

middleware for e-government services, information exchange platform, etc. Future services can then be quickly and efficiently added in a modular way without necessarily causing large disruptions for the overall system.

8.8.3 Collaboration with Other Cities

Collaboration with other cities to develop smart city services is a significant priority for many of the EU pilot smart cities. There are several established platforms such as CitySDK (www.citysdk.eu), Apps for Europe (www.appsforeurope.eu), etc., which are based on open platforms and provide tools that can be used to develop applications beneficial to the whole of the EU. The EU and China partners (DG CNECT and MIIT) may wish to explore expanding access to these platforms to Chinese cities.

Chapter 9
Next Steps

As smart city projects present a considerable challenge to the cities and their staff, capacity building is crucial to the success. *This is especially in the areas of assessment of technology alternatives, the design and management of public-private partnerships and the utilisation of modern management systems and technologies for the increasingly complex systems that modern cities are.*

Because of this need, knowledge-exchange platforms will continue to play an important part in enabling cities to achieve the respective next level of smart city maturity. Ideally, policymakers, industry and cities themselves would establish such platforms for know-how exchange dedicated to very specific systems, applications or other challenges.

The link between cities and enterprises needs to be strengthened so as to allow both sides to benefit from their partnership. City administrations need to actively involve industry in the earliest stages of smart city planning in order to follow a development path that is both technologically and financially feasible and sustainable. The enterprises offering smart city-related solutions need to understand the different perspectives of city administrators and create products and solutions that match the need of a city government for economising on scarce resources while also following a wider range of policy goals. Platforms and forums bringing these groups together to facilitate communication and the establishing of partnerships are encouraged.

With the existing activity on smart cities, this PDSF project seeks to support these efforts in know-how exchange and capacity building. This report will be presented to a group of senior representatives from the EU and China pilot smart cities who will meet in Beijing, April 28–29, 2014, for the 'EU-China Pilot City Exchange' seminar. At this seminar, the participants will have the opportunity to provide their feedback on the findings of the 'Comparative Study of Smart Cities in Europe and China'. Furthermore, break-out sessions at the seminar will enable participants to discuss the key challenges they have experienced when developing and implementing smart city projects. The pilot smart cities will exchange experiences on how to

China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8_9

best address these challenges and to suggest where applicable areas for further cooperation are. The participating pilot cities are encouraged to establish more formal clusters of cities with related interests, so that practical cooperation on specific solutions can emerge. Especially cities currently preparing the development of similar solutions should consider sharing this burden with other cities in the EU and/or China and benefit from each other's experiences.

An additional option for the cities seeking to further develop their smart city ambitions is to use the 'Smart City Assessment Framework' developed for the comparative study and use it as an internal management tool for assessing the status quo of the smart city development, to identify gaps and weaknesses and to focus on addressing those. This could prove a beneficial tool for cities interested in following a comprehensive and realistic development process.

The EU-China Smart City Cooperation Project Technical Expert Group that was established to provide additional expertise to the cooperation will continue to function as an 'EU-China Policy Dialogues Support Facility II' expert group with responsibilities for:

- Identifying and sharing 'good practice' in the various components of smart city projects in China and the EU, through electronic communication as well as personal meetings where possible to ensure that the benefits from the shared learning are achieved
- Identifying emerging challenges in smart city projects and establishing, where appropriate, an EU-China task force to address the issues
- Maintaining a database of technical experts to support smart city development projects in China and the EU

Annexure

Annex 1: Smart City Service Examples

Category	Smart city service examples
Energy and environment	***Automated metering project in Jeju Island, South Korea***
	KT and SKT are using the island as test bed for automated metering infrastructure, which is connected by both mobile and fixed networks to the electricity, water and gas suppliers. The infrastructure automatically detects leaks and provides accurate meter readings, improving reliability and reducing waste and costs. This is complemented by a building energy management system which enables citizens and businesses to monitor and control the energy usage of their buildings remotely via mobile networks
	The municipality has also introduced an electric vehicle service enabling straightforward car rental and sharing, supported by automated authentication and billing for electricity charging
	TrashTrack, various cities in the USA
	Developed by MIT's SENSEable Cities Lab, TrashTrack is an experimental use of wireless sensor networks to trace the movement of waste in the city. Using simple mobile phone technology, sensors are attached to consumer waste products, such as aluminium cans or coffee cups. The sensors report the location of the object in real time, as it embarks on its journey to landfill or recycling. This is then visualised and mapped, indicating how such techniques can provide insight into otherwise imperceptible urban processes

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China Academy of Information and Communications Technology and EU-China Policy Dialogues Support Facility II, *Comparative Study of Smart Cities in Europe and China 2014*, Current Chinese Economic Report Series, DOI 10.1007/978-3-662-46867-8

Category	Smart city service examples
	Rede Ampla, Rio de Janeiro
	Ampla is an electric energy distributor, which provides electricity to 73 % of the state of Rio de Janeiro. The rate of urbanisation, the nature of the accommodation (slums) and the high crime rate led to an unsustainable level of energy theft and bad credit risk. A large number of customers did not have access to personal banking services. Meters at residential and commercial sites were prone to tampering and bribes to employees encouraged fraud. Ampla was averaging 23.6 % energy losses on its network, reaching up to 52 % in some areas. The result was a negative impact on the utility's profitability and a higher cost of energy passed through to its customers
	In 2003, Ampla began to roll out a pilot for a new mode of smart meter – located at the pole top – entitled Rede DAT. With Rede DAT, the consumption per household is recorded at the transformer, and energy consumption data is communicated by the utility over a mobile network. Energy customers receive consumption data through their mobile phone
	The pilot proved a great success with losses from theft reduced by more than 50%, the number of supply interruptions reduced by more than40 % and lower operating costs. A wider rollout followed, providing hundreds of thousands of Ampla's residential and business customers with access to the Rede Ampla service
	Water management, South Bend, Indiana, USA
	The city of South Bend has used the IBM Intelligent Operations Centre (IOC) dashboard since late 2011 to view data pooled from the city's smart valves and sensors. This has reduced wet weather wastewater overflows by 23 % and almost entirely eliminated dry weather incidents such as clogged sewers. The city was also able to avoid USD 120 million in infrastructure upgrades, and the application is helping to avoid USD 600,000 in potential government fines
	Water management, Mumbai, India
	When Itron meters were installed in 2012 in Mumbai, India's largest city, they cut water losses by 50 %. Before, the system only managed to provide water to about half the city's 13 million residents for a few hours a day. The other half got nothing at all. One reason: about 50 % of the city's potable water was lost to leaks
	The metering helped the Municipal Corporation of Greater Mumbai find leaks and discouraged waste so more residents could get water. Itron officials note they've seen similar water savings in Africa
	Smart streetlights
	Across the globe, LED and smart streetlights are helping to establish smart cities and represent a critical layer of the emerging 'Internet of Things'. By 2025, cities and municipalities are projected to save $11.3bn (more than 86,000 GWh) per year from efficient LED and smart streetlights. Investment in this technology will reach $72 billion cumulatively by 2025, according to a study published today by Northeast Group, LLC
Transport	***SFpark project, San Francisco***
	The project is designed to reduce traffic by helping drivers find parking spaces. SFpark collects real-time information (using wireless parking sensors) about where parking is available and then distributes that information via a smartphone app to drivers. It also periodically adjusts meter and garage pricing up and down in line with demand, encouraging drivers to park in underused areas and garages, reducing demand in overused areas

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Category	Smart city service examples
	The project is 80 % funded by the US Federal Government and may generate a small amount of revenue for the city by increasing utilisation of parking spaces and by better matching parking tariffs to demand
	Cabspotting, San Francisco
	Cabspotting, by San Francisco Exploratorium and design firm Stamen, traces San Francisco's taxi cabs as they travel throughout the Bay Area. The patterns traced by each cab create a real-time map of patterns of movement and urban activity across the city. The data is derived from GPS tracking devices fitted into yellow cabs and used by dispatchers. Numerous visualisations have been produced based on the data, all exploring what insightful information about the city can be derived from the data
	u-Shelter: State-of-the-art bus stops, Seoul
	Introduced in 2009, Seoul's u-Shelter bus stops incorporate state-of-the-art ICTs to offer citizens a variety of smart services. In 2011, each u-Shelter interacted with an average of 2,518 people each day – with bus route guide the most frequently used service at 1,427 times per day, followed by digital map(764), destination search (135), traffic broadcasting station (65) and weather forecast (59)
	Toyota City, Japan
	Toyota City, as the home of the Toyota Motor Company, is unsurprisingly focusing on transportation and mobility issues for its smart city initiative. The city is developing a number of demonstration projects around sustainable transport, including a plug-in hybrid car-sharing system and the development of solar power-based charging infrastructure. The city is also piloting home energy management systems and demand response programmes
Public safety	***u-Seoul Safety Service, Seoul***
	u-Seoul Safety Service has been in operation since April 2008. It utilises location-based services and CCTV technologies to notify authorities and family members of emergencies involving children, the disabled, the elderly, and those suffering from Alzheimer's disease. Seoul has developed a smart device dedicated to this purpose, and when its holder leaves a designated safe zone or pushes its emergency button, an emergency alert is sent to guardians, police, fire departments and CCTV control centres
	To make use of the u-Seoul Safety Service, citizens are required to register with mobile carriers specifically designed for this purpose. Seoul provides low-income households and vulnerable groups emergency alert devices free of charge or at significant discounts, aiming to reach 50,000 registered users by 2014
Health	***Health-Lab, Amsterdam***
	Health-Lab is a project in the Amsterdam Metropolitan Area that aims to establish an environment which supports the creation and implementation of innovative care technologies. The programme focuses on increased care efficiency resulting in greater end user independence. At Health-Lab, care professionals, scientists and entrepreneurs work closely together with end users in seeking solutions. The potential of ICT-based technologies plays an important role
	To support and stimulate digital health developments in the Amsterdam Metropolitan Area, the project is set up around three pillars:
	Creating a platform where all those involved can meet, discuss and share developments in and implementation of new solutions in care

(continued)

Category	Smart city service examples
	Supporting and stimulating the set-up of several living lab locations where new solutions can be tested and improved, together with users
	Creating new curricula focussing on the implementation of these solutions in educational settings
Education	***School Newsletter application, Seoul***
	The citizen-developed School Newsletter Application connects schools with pupils' parents, instantly notifying parents of changes in academic schedules or the items students are required to bring to school for the following day's lessons. This is achieved by way of an online 'school board' alerting parents of changes to its content whenever it is updated. 100 elementary schools currently make use of this service, and more are encouraged to do so via 'I am school'
Economic stimulus	***Busan, South Korea***
	Busan is South Korea's second largest city and the fifth largest container-handling port in the world. With an economy based on heavy industry, Busan confronts challenges similar to those of other large, industrial cities. A primary challenge for Busan is creating job opportunities for its 60,000 annual university graduates and retaining a high-quality workforce. The Busan Metropolitan Government recognised the potential for growing its economic base through the use of ICT. By connecting citizens, educational institutions, government agencies and industry, the city could drive sustainable urban development while providing citizens with easy access to city services
	A cloud infrastructure provided by Cisco connects the Busan Metropolitan Government, the Busan Mobile Application Centre (BMAC) and five local universities. Eventually, it will deliver services to citizens through kiosks, citywide digital interactive displays, home-based access and mobile access. The first major cloud-based initiative is designed to create 3,500 job opportunities and 300 start-up companies focused on mobile application development by 2014. Spearheaded by the Busan IT Industry Promotion Agency (BIPA), the project will create an open innovation ecosystem that fuels the app economy of Busan. The Busan Metropolitan Government funds ICT development and provides training and education through the BMAC. Software developers, entrepreneurs and small businesses can register and gain access to tools, training and testing resources for developing smart applications and mobile app-based services for citizens. Revenue generated is returned to developers through BIPA
	BMAC offers physical workspaces, such as project and meeting rooms, shared application development, cloud platforms for Windows and Mac operating systems, application library, consulting centre for start-ups and small office/home office professionals, testing tools, smart devices, application programming interfaces for access to municipal data, application developer's forum and marketing resources
Open data	***LIVE Singapore!***
	LIVE Singapore! is a research project led by MIT's SENSEable City Lab focused on the development of a platform for the collection, combination and distribution of real-time data sets from urban systems and networks, such as vehicle fleets (taxi, bus, subway), telecommunication networks (mobile phone, landline, Wi-Fi), seaport and airport operations, environmental sensor networks and user-generated data

(continued)

Category	Smart city service examples
	Examples of the applications that have been developed include the following: (i) Mapping carbon emissions – by using GPS, speed and accelerometer data on vehicle fleets, insights can be gained in real-time regarding where traffic flows generate high CO_2 emissions. This enables joggers, bikers and others to avoid high-pollution areas and is a valuable input to transportation route planning to help reduce emissions. (ii) In 2009, Singapore's Energy Market Authority launched a smart meter pilot project. By allowing homeowners to access their personal energy consumption information, pilot trials reveal that they can derive at least a 2 % reduction in overall energy consumption and a 10 % reduction in peak consumption. By overlaying energy data, various incentives and consumer attitudes and preferences, the project can better understand people's usage and help to tailor the specific messages to drive greater savings
	DataSF, San Francisco
	In 2009, San Francisco became one of the first cities to share its data publicly through its open data effort – DataSF. DataSF has over 200 data sets from dozens of city agencies available, and dozens of apps have been created from this data
	Some examples include (i) Neighbourhood Score which provides an overall health and sustainability score, block by block for every neighbourhood in the city of San Francisco. The application is based on a holistic model, which identifies assets and hazards in the physical and social environments of any given urban area. The app can be used to assess liveability, identify success and failures in various communities and an advocate for a healthier city on a street-by-street basis – empowering residents and elected officials. (ii) EcoFinder helps citizens find out where to recycle and properly dispose of material by providing the relevant businesses and services closest to their home
	Sensing City, Christchurch, New Zealand
	Christchurch suffered a series of major earthquakes in 2010/2011 that destroyed the entire central business district. The Sensing City project will incorporate sensors in the rebuilt infrastructure to monitor everything from noise levels to water use in real time at a granular level. It will also add data from existing databases (such as traffic flow) as well as information from the systems that control building management systems. The aggregated data will be available in an open data store where it can be analysed by city officials and citizens
	One of the first projects under development will examine the correlation between air quality, air temperature and incidences of respiratory illness. Sensors on inhalers will monitor when people require relief from exacerbations of chronic obstructive pulmonary disease. These sensors will relay real-time data about the quantity of medication dispensed, the air temperature at the mouth and the location. Coupled with this will be real-time data from across the city at a granular level that captures the level of particulates in the air. This project has a number of measurable benefits to the city, the health system and also the patient

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Annex 2: EU-China Cooperation Facilities Relevant to Smart City Projects

EU-China urbanisation partnership and the EU-China Mayor's forum EUROCITIES is involved together with the Committee of the Regions, led by DG ENERGY http://ec.europa.eu/energy/international/bilateral_cooperation/china/china_en.htm
The EU-China environmental governance programme In partnership with the Chinese Ministry of Environmental Protection, this programme aims to contribute to the strengthening of environmental governance in China through enhanced administration, public access to information, public participation, access to justice and corporate responsibility in the environmental field http://www.ecegp.com/index_en.asp
The EU-China environmental sustainability programme (ESP) The project aims to support China's efforts to meet the environmental and climate change targets defined in the 12th Five-Year Development Plan https://webgate.ec.europa.eu/europeaid/online-services/index.cfm?do=publi.welcome&nbPubliList=15&orderby=upd&orderbyad=Desc&searchtype=RS&aofr=133582&userlanguage=en
The China-Europe water platform (CEWP) The EU and China agreed at the 6th World Water Forum in Marseille (March 2012) to establish the Water Platform with the support of the EU's Water Initiative. The platform aims to achieve an integrated approach to water management in China http://eeas.europa.eu/delegations/china/press_corner/all_news/news/2012/20120314_en.htm
EU-China sustainable urbanisation park Pilot project under the EU-China Partnership on Urbanisation. The partnership aims at promoting exchanges and cooperation in a wide range of sustainable urban developments http://www.sustainable-urbanisation-park.com/index.php?m=content&c=index&a=lists&catid=82
Europe-China clean energy centre (EC2) The Europe-China Clean Energy Centre (EC2) is a five-year cooperation project funded by the European Union and founded by the European Commission, the National Energy Administration of China and the Ministry of Commerce of China, with the support of the Italian Ministry for the Environment, Land and Sea Led by Politecnico di Torino (Italy) http://www.ec2.org.cn/en
Europe-China research and advice network (ECRAN) The project is designed to further enhance the capacity of European policymakers to monitor and assess current developments in China http://www.chathamhouse.org/research/asia/current-projects/europe-china-research-and-advice-network-ecran
Urban reduction of GHG emissions in China and Europe (URGENCHE) A project bringing together a team of internationally recognised scientists to develop and apply a methodological framework for the assessment of the overall risks and benefits of alternative greenhouse gas (GHG) emission reduction policies for health and well-being in China and Europe http://www.urgenche.eu/

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URBACHINA URBACHINA will analyse China's urbanisation trends for the next 40 years and define possible future scenarios with reference to concepts of sustainability http://www.urbachina.eu/index.php/en/
EC-Link
The aim of the project is to support China in meeting the environmental, energy and carbon intensity targets defined in the 12th Five-Year Development Plan
The purpose of this contract is to provide technical assistance to the Chinese Ministry of Housing and Urban-Rural Development (MOHURD). Through providing technical assistance to MOHURD, the EC-LINK's project purpose is to assist Chinese cities in adopting energy and resource-efficient ecological solutions by sharing experiences on sustainable urbanisation and other relevant policies between Europe and China
To be launched later in 2013 and led by DG-ENER

Annex 3: EU Smart City Knowledge Exchange and Cooperation Platforms

Platform	Description
Smart cities council http://smartcitiescouncil.com/	The Smart Cities Council is an advisor and market accelerator. It promotes the move to smart, sustainable cities. It does so by preparing the following:
	Readiness guides: High-level models and metrics against which cities can measure their progress
	Financing templates and case studies: Guidance for new financing models now emerging, some of which combine public, private, philanthropic and development sources
	Policy frameworks and case studies: Examples of policies that promote economic development while also safeguarding citizens
	Visibility campaigns: These campaigns include awards, events, publishing and research
	Regional networking events: High-level, invitation-only events where cities and their citizens can learn directly from some of the world's top experts in the many disciplines that combine to create a smart city
	The Smart City Council's website offers a wide range of information that can be relevant for other cities preparing their own projects, in particular

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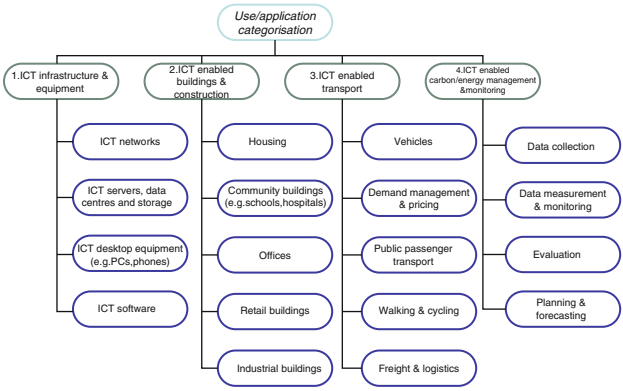
Platform	Description
	Smart city tools: http://smartcitiescouncil.com/smart-cities-information-center/smart-city-tools
	Citizen engagement strategies and tools
	Financing and procurement tools
	Policy frameworks and tools
	Research, publications and websites
	The SCC readiness guide
	Visioning and roadmapping tools
	Smart city examples: http://smartcitiescouncil.com/smart-cities-information-center/examples-and-case-studies
	Smart city concepts: http://smartcitiescouncil.com/smart-cities-information-center/smart-city-concepts
	Definitions and overviews
	Responsibility areas
	Built environment
	Economic development
	Energy
	Health and human services
	Public safety and security
	Telecommunications
	Transportation
	Water and wastewater
	The enablers
	Analytics
	Citizen engagement
	Computing resources
	Connectivity
	Data management
	Finance and procurement
	Instrumentation and control
	Interoperability
	Policy and leadership
	Security and privacy

(continued)

Platform	Description
eeRegio – ICT for energy efficiency local and regional initiatives http://ec.europa.eu/information_society/activities/sustainable_growth//eeregio/index_en.htm	The eeRegio Wiki is a resource for local, regional and national authorities (cities, municipalities and regions) throughout Europe. The Wiki and forum provide an extensive body of practical advice and examples of good practice in the planning and implementation of energy efficiency initiatives involving ICT
	Of particular interest to other cities should be: 'The Contribution of ICT to Energy Efficiency: Local and Regional Initiatives' (July 2011), Final report: A toolkit for local and regional initiatives
	http://ec.europa.eu/information_society/activities/sustainable_growth/docs/ict4ee_wiki/final_toolkit_master-p_v.pdf
	This toolkit includes practical guidance in the form of 12 'walk-throughs' to enable local and regional authorities to explore how to progress energy efficiency initiatives. It also features 23 case studies from across Europe, each one describing an example on how ICT projects were developed and implemented
	The project categories covered in the toolkit are: 
EPIC www.epic-cities.eu	EPIC's objective is to be a service innovation and delivery platform (with roadmap) for medium-sized (50,000–500,000 habitants) cities across Europe, where any city can cost-effectively share, access and adapt a range of services to work smarter to meet the needs of their citizens, visitors and a wide range of business/social relations
Open cities – open innovation mechanism for smart cities http://www.opencities.net/	The aim is to help apply open innovation as a process for innovation management for cities. The project seeks to (1) distil insights and best practices on how to apply open innovation in the public sector, (2) gain understanding on the management of technological platforms in an open innovation context, (3) validate the use of Pan-European platforms for crowdsourcing, open data FTTH networks and Open Sensor Networks, (4) trigger the development of Advanced Future Internet Services by leveraging existing tools, trials and platforms in Crowdsourcing, Open Data, Fibre to the Home and Open Sensor Networks in five major European cities, (5) support the effective application of Living Labs for promoting the adoption and cocreating of innovation in smart cities

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Platform	Description
PEOPLE http://www.people-project.eu/portal/	Within the context of ICT services for 'smart cities', the PEOPLE (Pilot Smart Urban Ecosystems Leveraging Open Innovation for Promoting and Enabling E-Services) project is focused on implementing innovative Internet-web services to facilitate citizens' daily lives, using them as a primary source in the definition of requirements. PEOPLE consists of four Pilot Smart Open Innovation Urban Ecosystems (PEOPLE Pilots) created to become seeds towards sustainable smart cities based on ICT services
ICT4E2B (2010–2012) http://ict4e2b.eu/	European stakeholders' forum crossing value and innovation chains to explore needs, challenges and opportunities in further research and integration of ICT systems for energy efficiency in buildings. The project's aim was to bring together relevant stakeholders involved in ICT systems and solutions for energy efficiency in buildings at identifying and reviewing the needs in terms of research and system integration as well as at accelerating implementation and take-up
SEAP – how to develop a smart city action plan http://www.covenantofmayors.eu/IMG/pdf/SEAP-ENG-final.pdf	The Covenant of Mayors (which is not limited to EU cities) facilitated a project supporting the cities of Polotsk and Salé in drafting and launching Sustainable Energy Action Plans (SEAPs), allowing them to implement the 20-20-20 strategy of the EU. The resulting publication is very useful in clarifying what a SEAP is, why cities need it and how to develop and implement such a plan. The scientific approach on energy management promoted through SEAP means that each action is calculated in terms of environmental and financial efficiency. Frequent energy diagnosis and emission inventories have proven to be crucial elements in the design and implementation of the plans
	A SEAP development guideline and a template are available on the Covenant of Mayors website, which is also a useful input for cities not member of the covenant. Past experiences of covenant members and experts provide valuable guidance on the necessary steps towards developing an action plan as part of a smart city programme
	Guidebook: http://www.eumayors.eu/IMG/pdf/seap_guidelines_en.pdf
	Template explanation (http://www.eumayors.eu/about/covenant-step-by-step-seap-submission_en.html) and download (www.eumayors.eu/IMG/xls/template_en.xls)
Connected smart cities http://connectedsmartcities.eu/	The Connected Smart Cities Portfolio Network has been established to provide an open and collaborative framework for smart cities to cooperate, network and share their experiences. This is a result of the FIREBALL project, which brought together three key communities: the Living Labs, the Future Internet research community and cities. This is supported by the European Network of Living Labs and EUROCITIES
	City profiles: http://connectedsmartcities.eu/city-profiles

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Platform	Description
Smart cities EU http://www.smart-cities.eu/	This was a project ranking smart cities based on a comprehensive catalogue of indicators, with special focus on taking the role of medium-sized cities in Europe and their respective differences and comparative (dis)advantages into account. It seeks to provide an in-depth analysis for every city based on the comprehensive description of characteristics and the large number of indicators developed
	Final report: http://www.smart-cities.eu/download/smart_cities_final_report.pdf
	Additional project documentation: IFHP Congress Copenhagen http://www.smart-cities.eu/download/city_ranking_final.pdf Results indicators: http://www.smart-cities.eu/download/results_indicators.pdf
EU smart cities stakeholder platform http://www.eu-smartcities.eu/	The Smart Cities Stakeholder Platform was initiated by the EU Commission with the dual aim of (i) identifying and spreading relevant information on technology solutions and needs required by practitioners and (ii) providing information for policy support to the High Level Group and the European Commission. It is both a web-based and physical platform open to anyone who registers on it. The backbone is the contributions by stakeholders in a bottom-up way, owned by the stakeholders
	Smart city profiles: http://www.eu-smartcities.eu/smartcities-profiles
Smart cities in Europe http://www.smartcitiesineurope.com/	S*martcitiesineurope.com* is a platform that seeks to bring together the learning from various projects across Europe. The initiative includes a practical route to smart cities, learning sessions and publications
	Best practices section: http://www.smartcitiesineurope.com/category/best-practices/?orderby=title&order=ASC
CitySDK http://www.citysdk.eu/	CitySDK works on the transfer of smart city applications from one city to another. It seeks to address the lack of unified back-end technologies, innovative end user services and unified markets beyond single cities. It aims to create a smart city application ecosystem through large-scale demand-driven city pilots that package and align key smart city application areas to an open-source service developer toolkit
	First, an open-source service developer toolkit for European Smart City Applications will be developed (CitySDK). Second, developers will be involved to the use of this CitySDK (such as private developers, SMEs, Cities' ICT departments and hacktivists). The consortium consists of 22 partners in 9 European states: SMEs, ICT and media companies, research institutes and eight cities

Annex 4: EU Funding Sources for Smart City Projects

Budget allocation per programme and climate earmarking

MFF Headings	Sub-total per programme	Climate earmarking %	Climate earmarked in € million	Description / Comment
HEADING 1: Smart and inclusive growth				
Horizon 2020	€87 000 mln	35 %	€18 500 mln	Contributions include the following: Secure, clean and efficient energy with a proposed budget of €6.5 billion Smart, green and integrated transport with a proposed budget of €7.7 billion Climate action, resource efficiency and raw materials with a proposed budget of €3.6 billion *Calls for projects specific to Smart Cities will be launched, and other calls may be linked to urban needs, such as grids, waste to energy, etc.*
COSME	€2 500 mln			The programme will target actions to improve and strengthen the competitiveness and sustainability of EU enterprises, and in particular of SMEs. This programme can be used to support the development of skills and innovative companies offering the services required in a smart city

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MFF Headings	Sub-total per programme	Climate earmarking %	Climate earmarked in € million	Description / Comment
Sub-heading: Economic, social and territorial cohesion				
Cohesion Policy, including ERDF and ESF	€325 149 mln	20 % of national ERDF allocations in developed/ transition regions 6 % in less developed regions	€ 16 000 for EE/ RES investments. **A minimum of €16 257 mln for urban areas**	The earmarked funds concern only EE/RES activities as proposed by the EC. Other climate related activities in the transport sector or in relation to climate change adaptation could also be financed outside of the earmarking exercise. ***Additionally, a minimum of 5 % of national ERDF allocations are earmarked for sustainable urban development activities***, which could include activities related to transport, energy and ICT. *The urban dimension of these policies will depend on regional plans*
CEF – Transport, energy and ICT	€29 300 mln			The CEF is dedicated to Trans-European Networks. These will have an impact on decisions at local level, as local infrastructures will need to adapt. Will the region, for example, be well connected to external sources of, or demand for, energy?
HEADING 2: Sustainable growth: natural resources	€386 472 mln			

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MFF Headings	Sub-total per programme	Climate earmarking %	Climate earmarked in € million	Description / Comment
CAP: Pillar 2 EARDF	€85 000 mln	25 % (although it should be noted that this is not a binding requirement for Member States)	€ 21 250 mln	The rural development funds aim at investing an important share of the funds on climate related investments. These can be of relevance to urban areas in particular if related to energy production. The development of stronger links with rural areas and the exploitation of possible new market opportunities should also be considered
LIFE+	€3 600 mln		€ 902 mln	The new 'climate change' component of the LIFE programme can be used to promote both mitigation and adaptation activities in urban areas. These can be related to seed capital, testing and pilot projects, exchange of good practice and improving governance

Overview of instruments, respective activities and target groups

Programme	Financial instrument	Objectives and types of activities	Target/Beneficiary instrument
HEADING 1: Smart and inclusive growth			
Horizon 2020		The programme is designed to support RDI (Research Development and Innovation) activities, but also to address failures by supporting high risk and long-term RDI that would not necessarily be pursued otherwise. The focus includes *inter alia* **secure, clean and efficient energy** (including the successor to the IEE II); **smart, green, integrated transport and climate action**	Any public or private entity. Particular attention shall be paid to SMEs. market

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Programme	Financial instrument	Objectives and types of activities	Target/Beneficiary instrument
	Debt facility	The debt facility aims to address a current gap in the market between the demand for and supply of loans and guarantees for risky R&I investments, building on the RSFF. The RSFF is largely demand driven, so climate, energy, transport and ICT related activities are not the only focus. However, the EIB does give more weight to projects that are in line with the EU climate objectives	Legal entities of all sizes, SMEs with the potential to carry out innovation and grow rapidly; mid-caps and large firms; universities and research institutes; research infrastructures and innovation infrastructures; public-private partnerships; and special-purpose vehicles or projects
	Equity facility	The equity facility aims at improving the availability of equity finance for early and growth-stage investments, and to boost the development of the EU venture capital market. This should in particular help during the technology transfer and start-up phase, when new companies face the so-called 'valley of death', i.e. where public research grants stop and it is not yet possible to attract private finance	Enterprises of all sizes undertaking or embarking on innovation activities, with a particular focus on innovative SMEs and mid-caps. *This facility may be of particular importance to large innovative demonstration projects in cities.*
COSME		The programme will target actions to improve and strengthen the competitiveness and sustainability of EU enterprises, and particular SMEs; actions intended to develop new competitiveness strategies including *inter alia* design, implementation and evaluation of policies affecting the competitiveness and sustainability of enterprises, including disaster resilience and the development of sustainable products, services and processes; initiatives accelerating the emergence of competitive industries including initiatives to enhance productivity, resource efficiency, sustainability and corporate social responsibility	Existing entrepreneurs (small businesses in particular); Future entrepreneurs (including in young people) and national, regional and local authorities. These funds can be used by cities to develop new business models and the capacity and the economic fabric necessary to run an efficient smart city

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Programme	Financial instrument	Objectives and types of activities	Target/Beneficiary instrument
	Loan guarantee facility (LGF)		Expansion and growth-stage enterprises, in particular those operating across borders. It allows making investments in early stage enterprises in conjunction with the equity facility for RDI under Horizon 2020
	Equity facility for growth (EFG)		
Cohesion Policy, including ERDF, ESF and CF	Grants	Financing through both grants and innovative financial instruments can target all types of project pursuant to one of the 11 thematic objectives, including activities supporting the transition to a low-carbon economy, adaptation to climate change and risk prevention, sustainable and low-carbon transport, and eco-innovation in SMEs. These can include: productive investment, particularly job creation and SMEs support; investments in infrastructure in the areas of energy, environment, transport, and ICT; social, health and educational infrastructure; development of endogenous potential by supporting regional and local development and research and innovation; and technical assistance	Managing authorities who determine the specific target group / beneficiary for different priority axes across the Operational Programmes. These could be any public or private legal entity, SMEs, citizens NGOs, etc. and governmental agencies/utility providers in cases of public infrastructure
	Loans, guarantees, equity and risk-sharing mechanisms		
CEF	Grants	Projects of common interest in the area of transport, energy and ICT at Trans-European level	Project developers (which could be governmental bodies or private operators)
	Equity, loans and/or guarantees facilitated by risk sharing instruments, including enhancement mechanism to project bonds	Projects of common interest in the area of transport and energy	

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Programme	Financial instrument	Objectives and types of activities	Target/Beneficiary instrument
HEADING 2: Sustainable growth: natural resources			
European Agricultural Fund for Rural Development	Grants Loans, guarantees, equity and risk-sharing mechanisms	Financing through both grants and FI can target all types of project pursuant to one of the **6 priorities and 18 sub-priorities, know as 'focus areas', including activities supporting the transition to a low-carbon economy and adaptation to climate change and risk prevention**. Examples of funding could cover physical investments for rural infrastructure (such as investments for the installation of biogas plants, building insulation, modern machinery, etc.), and development of human capacity (such as training and the provision of advice)	The EAFRD targets farmers, forestry and other land managers as well as communities, businesses and individuals in rural areas. There is scope for a better integrated development with cities in the area of energy and transport, as well as water use distribution and efficiency
Environment and climate change (LIFE)	Grants Financial Instruments	The new 'climate change' component of the LIFE programme can be used to promote **mitigation, adaptation and governance activities**. The focus is pilot projects, demonstration projects; best practice projects; integrated projects, technical assistance, preparatory projects; and information, awareness and dissemination projects	Private (e.g. SMEs) and public bodies. Some of the LIFE funding will focus on cities according to the European Adaptation Strategy. In particular, larger cities will need an adaptation strategy as well as a mitigation one. These will need to be coherent

Source: Smart Cities Stakeholder Platform's Finance Working Group: 'Guidance Document: Using EU Funding Mechanisms for Smart Cities', 2013.

The following sites introduce almost all possible funding opportunities, projects, etc. for smart cities: http://ec.europa.eu/energy/technology/initiatives/smart_cities_en.htm and http://setis.ec.europa.eu/implementation/technology-roadmap/european-initiative-on-smart-cities.

Annex 5: Criteria for Assessment of the Maturity Level of Pilot Smart Cities

Characteristic	Level of maturity			
	Basic	Average	More advanced	State of the art
Smart city strategy	Smart city vision clearly articulated and related to overall city vision Limited strategic focus on ICT	Smart city vision contains objectives for at least some of the following factors: environment, energy, transport, waste management, urban-rural cohesion, quality of life Limited smart city key performance indicators (KPIs) ICT plan in place	Clearly defined and measurable smart city KPIs Smart city strategy or plan for the city	Smart city KPIs benchmarked against international standards, which are made available to all stakeholders ICT plans ensure that major technology trends are included in their city planning
Stakeholders	Stakeholder roles and relationships clearly defined but *no* citizen engagement in design of service	Stakeholder roles and relationships clearly defined with limited citizen engagement in design of service	Stakeholder roles and relationships clearly defined Citizen engagement in design of service, e.g. feedback loops, established	Use multiple forms of interactive technologies to engage with citizens, e.g. microblog, mobile social applications, crowdsourcing, gamification, etc., as mechanisms to engage with citizens Actively promote and publicise smart city developments to stakeholders Provide training to help citizens adopt new services

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Characteristic	Level of maturity			
	Basic	Average	More advanced	State of the art
Governance	Departmental governance structures	Cross-departmental governance structure is in place to ensure collaboration across the city planning development process	Citywide governance structures with shared performance targets across departments	Processes in place to: Allow stakeholders to participate in decision-making Ensure there is transparency and accountability of the various stakeholders
Funding	Funding for pilot project but no plan to expand funding beyond the pilot Basic monitoring of financial expenditure	Plans in place for raising funds to expand some pilot projects to full-scale rollout	Funding available to expand pilot to full-scale project Well-established system to monitor financial expenditure	No funding issues and funding available to meet al*l* smart city objectives
Value assessment	Smart city business case assessed on an individual project basis and considers only financial considerations	Some non-financial value assessed as part of the business case	The city has established a smart city evaluation framework, which includes some non-financial factors (e.g. social, environmental)	The assessment evaluates the *overall* impact (economic, environmental, social and cultural outcomes) of all smart city projects
Business models	Business models are unlikely to be sustainable beyond the pilot phase	Exploring a variety of different business models for pilot projects (some proven and others in the experimental stage)	Business models are likely to be scalable beyond the pilot phase (may not yet be proven)	Use a variety of business models that have been implemented for full-scale projects

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Characteristic	Level of maturity			
	Basic	Average	More advanced	State of the art
ICT infrastructure	Broadband (fixed, mobile or converged) network converge for all pilot projects ICT infrastructure provided for each project	Targeted ICT project investments (e.g. smart grid) Some of the ICT infrastructure is managed or shared across smart city projects	100 % citywide broadband coverage ICT infrastructure managed or shared across all smart city projects Funding for advanced broadband network (e.g. LTE, vehicular wireless network, sensors, etc.) and implementation of citywide data centres for future smart city projects	100 % high-speed (>20 Mbs) broadband coverage Real-time city operations are optimised ICT vision and strategy overseen by dedicated City CIO Measures in place to ensure that the city 'future proofs' its investment in ICT infrastructure
Smart city services	A few (<5) smart city services – some are pilot projects	Implemented several smart city services but some may still be pilot projects	A wide range of smart city services meeting the needs of a cross section of stakeholders Services have been implemented citywide	Several of the smart city services represent 'best practice' and have received awards for their services Smart city services are delivered through open data and crowdsourcing initiatives

Annex 6: Developing Citywide Industrial Cloud Services Platform, Chengdu, China

In 2013, the Ministry of Industry and Information Technology of the People's Republic of China started the development of the Industry Cloud Services Platform. Chengdu, as one of the pilot cities, heeded to the Ministry's call and developed a demo site of industrial cloud. This cloud project aims to build a first-grade information sharing platform in the global market offering cloud services for 2,000 enterprises in Chengdu's 21 industrial campuses. Once completed, this Chengdu-stationed cloud platform will provide services for the entire Sichuan province and make contribution to the development of China's Southwest region.

However, Chengdu faced the following challenges during the development of the industrial cloud ecosphere.

- ICT has already become a key factor in enterprises' operation and decision-making. Yet some of these enterprises do not have sufficient funds or technologies to follow the rapid ICT development.
- Enterprises data, though small in scale, are highly sensitive and valuable. Data loss or disclosure will seriously impact enterprises' daily operation, whereas developing comprehensive information security protection systems will bring excessive investment costs.
- Lacking unified technological standards and platforms, enterprises cannot effectively communicate or share information with each other. This substantially lowers their cooperation and interaction efficiency.
- Enterprises lack capabilities to develop, upgrade, configure and maintain information systems.

Chengdu has a number of industrial enterprises. Though achieved a lot in their own fields, these enterprises face challenges in ICT development. The city needs a comprehensive ecosphere to drive industry development. A customised cloud platform can effectively integrate industrial and ICT resources and facilitate the joint development of all enterprises in the industry chain.

The continuous development of cloud computing technologies brings Chengdu a group of leading enterprises in the field of cloud computing. The city has achieved significant progress in the implementation scale and technological capabilities of cloud computing. A comprehensive ecosphere that integrated industries and ICT technologies is taking shape.

Innovative Service Modes for Resource Integration and Enterprise Services

To lower the initial investment requirements, Chengdu develops its smart city data centre in the innovative BLO mode. Huawei and GDS jointly invest in the project. Huawei develops the information services platform, while GDS operates it. The Chengdu Municipal Economic and Information Commission, as the management department, procures services for enterprises during the support period. The government, Huawei and GDS seamlessly cooperate with each other to develop the comprehensive information services platform, serving thousands of enterprises in Chengdu.

Huawei's industrial cloud platform solution features enterprise cloud service integration, data security isolation and encryption and professional OAM services. The platform fully meets enterprise customers' requirements on service flexibility, data security and easy operation, improving their ICT levels.

Cloud Service Integration

The industrial cloud uses cloud computing technologies to provide diverse basic resource services, such as cloud host, cloud storage, cloud disaster recovery, virtual private cloud, cloud security and database services. In addition, the platform attracts multiple software service providers to offer the following applications:

- Customised CAE
- Customised data analysis
- Biological computing
- Biological medical database construction
- Biological information
- Comprehensive office
- ERP application
- e-Commerce application
- Asset management
- Logistics management
- Production management
- Order management
- Customer relationship management
- Document management
- Cloud desktop

The platform works as an ICT supermarket, allowing enterprises to freely choose reliable ICT products and services that they can afford.

The industrial cloud is becoming increasingly mature and providing diverse services, such as campus access control, intelligent video surveillance, parking management, emergency communication, infrastructure management, service hotline and investment management, effectively supporting smart campus development in Chengdu.

Enterprise-oriented Security Services

IT resource and data security deeply concerns enterprise customers. Huawei's industrial cloud uses layered architecture to offer hardened security protection for networks, hosts, VMs, applications and data, ensuring industrial enterprise customers' information security.

A technician who participated in the project gave the following comments on Huawei's system:

> Some enterprises need hardware isolation to ensure information security. Chengdu's industrial cloud provides independent devices to form private clouds for these enterprises. In addition, we add security tools, such as port scanners, cyber attack simulators, and firewalls in operating systems and bottom-layer software to ensure data security and service continuity.

An official of Chengdu Municipal Economic and Information Commission said, 'Huawei's public cloud solution has nature advantages in operation, services and

security, allowing carriers to offer cloud services with telecom-grade reliability. The public cloud platform serves as a cloud service supermarket to facilitate the development of an ecological chain in the cloud environment'.

Efficient OAM, Allowing Quick Service Deployment

The innovative service mode brings high requirements on easy operation. Huawei provides the ManageOne unified management platform to enable unified management for multiple cloud resource pools, significantly improving management efficiency and service quality.

The ManageOne operation platform uses flexible service modes to provide services for diverse enterprise customers. Its open interfaces enable SaaS customization and quick deployment of cloud services.

DCG's OAM personnel said, 'Easy management is of vital importance for use. Huawei's operation platform has convenient operation, flexible service modes and automatic service deployment. These features substantially improve our OAM efficiency and help us gain competitive edges in the service market'.

Significant Contribution to Industry Transformation

Chengdu's industrial cloud uses the technological platform to meet enterprise customers' service requirements, improve traditional industries, develop emerging strategic industries and exploit the industry ecosphere.

The deployment of the industrial cloud brings great social and economic benefits to Chengdu. Enterprises now have quick access to IT resources and can flexibly use and distribute these resources based on their service requirements. These enterprise customers are no longer troubled by ICT system development and OAM. The unified cloud platform offers them high-quality cloud computing services and helps them lower investment costs. Surveys show that renting ICT resources and services reduces the TCO by 55 % in 5 years compared to developing data centres. Therefore, enterprises can still enjoy higher cost-effectiveness by renting cloud resources when the support period ends.

The industrial cloud also brings a number of benefits to the local government. By improving public service and management levels and local enterprise competitiveness, the Chengdu municipal government gains considerable economic profits. The project has been proved to be a win-win solution.

The industrial cloud has completed its initial development and is now offering mature services for small and medium enterprises in local industrial campuses. The development plan and profit analysis shows that the cloud will provide over 200 applications by 2016, creating over 100 million RMB output value. Chengdu will utilise the platform to complete the development of its ecosphere.