EU-China Policy Dialogues Support Facility Ⅱ
中国－欧盟政策对话支持项目二期

EU-China Smart and Green City Cooperation

"Comparative Study of Smart Cities in Europe and China"- White Paper -

prepared for

Ministry of Industry and Information Technology (MIIT)

DG CNECT, EU Commission

with

China Academy of Telecommunications Research (CATR)

March 2014

Authors

Chinese expert team:

Kang Yanrong, Zang Lei, Chen Cai, Ge Yuming, Li Hao, Cui Ying

EU expert team:

Jeanette Whyte
Thomas Hart

Acknowledgements

Contents

List of Exhibits

1. Introduction and Background

At the end of 2011 in Chengdu, in the context of the 3rd ICT Dialogue Meeting between the Ministry of Industry & Information Technology (MIIT) and the European Commission's Information Society & 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. A "Comparative Study of Smart Cities in Europe and China" was initiated to provide an overview over smart city developments and challenges in the EU and China, with the aim of identifying current trends and providing participating smart cities with suggestions for next steps. The "Comparative Study" **forms the basis for this White Paper; it can be downloaded at http://www.eu-chinapdsf.org/.** This White Paper summarises the key findings of the report with the objective of supporting smart city decision makers in the EU and China on future actions to advance their smart city efforts.

The EU and China selected 15 pilot smart cities to participate in this study[1] and the 30 pilot cities are shown below in Figure 1.

Figure 1: Smart Cities Participating in the EU-China Cooperation

EU Smart Cities	Chinese Smart Cities
Amsterdam, Netherlands	Beijing Haidian District
Barcelona, Spain	Tianjin Binhai New Area
Bristol, UK	Shanghai Pudong New Area
Copenhagen, Denmark	Yangzhou of Jiangsu Province
Florence/Prato, Italy	Nantong of Jiangsu Province
Frankfurt, Germany	Huai'an of Jiangsu Province
Issy-les-Moulineaux, France	Ningbo of Zhejiang Province
Lyons, France	Jiaxing of Zhejiang Province
Malmo, Sweden	Zhangzhou of Fujian Province
Manchester, UK	Yantai of Shandong Province
Riga, Latvia	Guangzhou Nansha District of Guangdong province

---

[1] The criteria for selecting the 30 pilot cities can be found in section 4.2 in the final report "Comparative Study of Smart Cities in Europe and China".

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

2. International Smart City Concepts 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.

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 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?

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 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.

Most smart city projects are actually addressing the 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. 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 or the introduction of electric buses or bike-sharing schemes.

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 account of 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 Figure 2: Smart City Market Size.

Figure 2: Smart City Market Size

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[2]	• Market Global opportunity in Smart City market to total USD 3.3 trillion by 2025
GSMA's Connected Living tracker[3]	• In 2012, there were 257 mobile smart city projects of trial or commercial projects in Americas (38), Europe (166), Asia (38) and Africa/Oceania (11)
International Data Corporation[4]	• Estimate mainland China's city market to be worth $10.8 billion in 2013 and forecasts double-digit growth for the next five years.
Lee & Hancock's analysis of data from IBM, CISCO, ABI Research, Gartner (2012)[5]	• In 2012, there were 143 smart city projects on-going or completed in North America (35) South America (11), Europe (47), Asia (40) and Middle East & 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 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. Section 2.2 of the "Comparative Study of Smart Cities in Europe and China" report provides several examples of 'good practice' in the development of smart cities and readers of this white paper are highly recommended to read this chapter.

2.2.1. The Governance Challenge

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] 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
[3] Source: GSMA Connected Living Tracker http://www.gsma.com/connectedliving/tracker
[4] Source: IDC's China 100 Smart Cities Evaluation and Recommendation: Penetrating the Appropriate Target Cities Is Key; July 2013
[5] "Toward a framework for Smart Cities: A Comparison of Seoul, San Francisco & Amsterdam"; Jung-Hoon Lee Associate Professor, Graduate School of Information, Yonsei University, Seoul, Korea and Marguerite Gong Hancock Associate Director, Stanford Business School

2.2.2. The Financing Challenge

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 banks such as is the case for Masdar City[6] 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

2.2.3. The Business Model Challenge

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

2.2.4. The Services Challenge

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, enhance safety and security.

Most of the services developed to date are focused on smart energy/environmental and transport projects as Municipal governments are 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.

---

[6] Masdar City is a green-field 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.

- 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.

2.2.5. The Technology Challenge

The "Comparative Study of Smart Cities in Europe and China" report explores in some detail 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.

2.2.6. 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 program 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 United States, 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.

2.3. Development in EU and China

2.3.1. Developments in China

The urbanization process has accelerated in China, particularly during the past 10 years with the urbanization rate reaching 52.6% in 2012. Urbanization is part of China's modernization process and provides the biggest potential for enlarging the domestic economy.

At present, the relevant government departments and various cities in China are positively promoting smart city development. Ministry of Industry and Information Technology (MIIT), National Development and Reform Commission (NDRC), 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.

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[7]. The *Opinions* requires all pilot cities to issue policies to encourage market-based investment and financing, information system service outsourcing and socialized development and utilisation of information resources. The *Opinions* supports 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 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[8].

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[9]. During the "Twelfth Five-year Plan" period, the plan investment in Chinese smart cities is expected to be more than 1.6 trillion Yuan[10].

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

- **MIIT**
  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.

- **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.

  The Opinions proposes 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 proposes 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.

- **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*

[7] Several Opinions on Promoting Consumer Spending on Information Technology and Expanding Domestic Demand, http://www.miit.gov.cn/n11293472/n11293877/n15578381/n15578441/15578731.html.
[8] 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
[9] The sStructural hierarchy of the administrative divisions of the People's Republic of China comprises of 5 levels: Provincial, Prefecture, County, Township and Village
[10] *Report on Study of the Progress and Problems of Smart City Development in China*, CATR, 2013

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.

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.

2.3.2. 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.[11] 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.

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 – produce more pressure on finding solutions for problems such as provisions of public services, health care, 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.

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[12].

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

> **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 drop-out rate
>
> 20m Fewer people in or at risk of poverty and social exclusion

---

[11] http://europa.eu/rapid/press-release_IP-12-760_en.htm
[12] See Deakin, JESSICA for Smart and Sustainable Cities: Defining Smart and Sustainable 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'.[13]

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, the "Advisory Group 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):[14]

- 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; and
- Existing technology platforms, trade organisations and networks of towns and cities should be involved in the programme and in projects.

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:[15]

- **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.[16]
- **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 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 wakes of city life, if dynamic entrepreneurs can use government data

---

[13] http://ec.europa.eu/energy/strategies/2010/2020_en.htm.
[14] Smart Cities Report, Advisory Group Workshop, 16/09/2011;
http://ec.europa.eu/information_society/activities/sustainable_growth//docs/smart-cities/smart-cities-adv-group_report.pdf

[15] http://europa.eu/rapid/press-release_SPEECH-13-680_en.htm?locale=en
[16] See http://ec.europa.eu/digital-agenda/en/connected-continent-legislative-package for more details.

to develop convenient and intelligent offerings to the citizens, to the administration and to local enterprises.[17]

- **Entrepreneurs and start-ups:** Initiatives such as the "Future Internet Lab"[18] promote a dynamic entrepreneurial culture around the smart cities, intended to create synergies and the creation of 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 faster 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 regards to bandwidth, speed, reliability and security in an age of ubiquitous computing and Internet of Things calls 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.[19]

- **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.

While the European Innovation Partnership on Smart Cities and Communities 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 quality of life and the environment. A detailed discussion of the other policy measures is beyond the scope of this study. However, considering them all as part of one coherent framework is strongly recommended

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.

---

[17] 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.
[18] See Commissioner's speech at the launch event: http://europa.eu/rapid/press-release_SPEECH-13-671_en.htm
[19] See http://ec.europa.eu/digital-agenda/en/towards-5g for more details.

3. 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 practise" 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; and
- understand emerging challenges in smart city projects.

The assessment framework incorporates the findings from several papers that have proposed Smart City frameworks. 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.

The Assessment Framework is included as Annex 1 to this White Paper.

4. Analysis of EU and China Pilot Cities

A synopsis of the completed "Smart City Assessment Framework" is provided in chapter 5 of the "Comparative Study of Smart Cities in Europe and China". In chapter 6 of the report the information provided by the EU[20] and 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[21]. A summary of the results is provided in Figure 3:

Figure 3: Summary of the Results from the Assessment of the Pilot Smart Cities

Characteristic	Region	Level of Maturity					Not assessed
		Not yet addressed	Basic	Average	More Advanced	State-of the -Art	
Smart City Strategy	China		7%	27%	67%		
	EU			29%	70%	10%	
Stakeholders	China			60%	40%		
	EU		10%	10%	60%	10%	
Governance	China			7%	93%		
	EU			20%	40%	20%	20%
Funding	China			87%	13%		
	EU		10%	60%	20%		10%
Value Assessment	China		7%	53%	27%		13%
	EU	10%		10%	40%		40%
Business models	China			20%	47%		33%
	EU			20%	40%		40%
ICT infrastructure	China		7%	13%	80%		
	EU			10%	80%		10%
Smart city services	China		13%	87%			
	EU				80%	10%	10%

5. 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 are summarised below. Readers of this white paper are highly

---

[20] The analysis is based on the ten pilot cities that provided the information by the deadline for the completion of this report (Barcelona, Bristol, Copenhagen, Florence, Issy-les-Moulineaux, Malmo, Manchester, Tallinn , Venice and Zagreb)

[21] Criteria for Assessment of the Maturity Level of Pilot Smart Cities are provided in Annex 2 of this White Paper.

recommended to read chapter.7 of the "Comparative Study of Smart Cities in Europe and China" where a more detailed description together with specific examples of the pilot smart city use cases can be found.

5.1. 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.

Citizen engagement: Many smart cities, especially in the EU, have implemented 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 city modernisation and smart city plans.

- *Integrated management structures:* While most cities rely on the coordination between existing departments, several pilot smart cities have implemented more integrated management structures that are intended to enable faster and more accountable decision making. 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.
- *Benchmarking and Key Performance Indicators (KPIs) Many* pilot smart cities have already developed and publish KPIs. Some of the cities benchmark their KPIs against international standards.
- *Open data infrastructu*re: Most EU pilot smart cities have implemented open data infrastructure projects, which enable businesses and citizens free access to city data. For the Chinese pilot cities, this is at an earlier stage, but most are in the process of establishing such open data systems and portals.

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 as well as large-scale, formal institutions. 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 socioeconomic 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. While a considerable number of citizens do not have access to such technologies, the provision of public services needs to be planned as a multi-channel strategy, including offline provision in order to ensure equal access for all groups. This thwarts the potential efficiency gains smart city programmes can offer.

5.2. 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.

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. Other EU pilot smart cities have received funding by participating in EU funded smart city projects such as Commons4EU[22], Open Cities[23]and CitySDK[24] .

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 via 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.

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 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 generates 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 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. Concerns over local government were recently highlighted by a growing number of domestic rating agency downgrades of LGFV credit ratings for Chinese cities. These downgrades will lead to higher

---

[22] Commons4EU (www.commonsforeurope.net) is an EU funded project (36 months, commencing November 2011)

[23] Open Cities (www.opencities.net) has 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).Understanding how Living Labs could be effectively applied for promoting the adoption and co-creating of innovation in Smart Cities.

[24] 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

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. Even though the local debt levels tend to be 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.

5.3. Business Models

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. Cloud-based, pay-as-you-go" business models have been implemented by some pilot smart cities. Some Chinese cities have established partnerships with telecom operators which provide value added smart city services to citizens on a profit/cost sharing basis. Some European cities have implemented a business model whereby the city collects revenues from other parties that use the municipal network infrastructure.

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 this is a key challenge and are testing new business models in pilot projects to see if they will scale up for city-wide implementation and for a duration beyond the allocated project stage. Few examples were identified where a smart city has commissioned analysis to assess different business models for commercialising smart city services and to identify the best business model (s) for the city.

5.4. Smart City Services

Environmental/energy and transport applications are the most popular services implemented by the pilot smart cities. A large number of Chinese pilot smart cities have implemented public administration projects as part of their smart services portfolio. Most EU administrations, in contrast, have not mentioned such services as specific part of their smart city portfolio, they tend to be considered a separate effort, and usually with a longer history.

- All EU pilot smart cities have implemented open data projects. Investment in open data projects is likely to continue driven by the potential economic value that can be created by open data. Although open government data policies have spread fast, the availability of truly open data remains low and no country can yet claim to be fully 'open by default'.
- Some of the more advanced pilot smart cities have developed a large number of smart city applications. Increasingly cities in Europe are willing to collaborate and share their smart city applications with other cities, through a number of cooperation and knowledge-sharing platforms.

Challenges

The key challenges the pilot smart cities are likely to face in the area of developing smart city services include:

- 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.

5.5. Technology

Several technology trends and open challenges to generate innovative smart city services have been identified in the following areas:

- **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. *Challenges:* This is linked to the general challenge of improving national and regional broadband infrastructure, with the implied high investment costs and the need to establish new co-financing models and innovative business models for operating the networks. As most smart city projects are characterised by high population density, the challenge is less severe, however, as the roll-out of high-quality infrastructure in remote areas.

- **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. *Challenges:* Some IP networks are not yet "IoE ready" and require upgrading; a lack of IoE skills and knowledge can hamper the implementation progress; issues of trust and security are identified with the generation and processing of large amounts of data; concerns about widening the Digital Divide by excluding less technology-savvy groups need to be addressed.

- **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. 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 citizens. *Challenges:* the key challenge is to consider the growth of smartphone availability to ensure that services exclusively offered for smartphones or exclusively making use of smartphone data are only representative for a certain percentage of the population. Also, the use of smartphones for service offering and data collection raises concerns about data protection and security issues.

- **Cloud computing**
  Most pilot smart cities have deployed cloud computing to reduce the overall cost of providing services and/or deliver more responsive services for their citizens. Whilst most of the Chinese

pilot smart cities are in the early stages of implementing cloud computing many of the EU pilot smart cities have significant experience. *Challenges:* 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, complexity of managing cloud components, privacy concerns, or interoperability between clouds and the danger of vendor lock-in.

- **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. *Challenges:* There are some challenges to overcome for cities to capture the full potential of big data, including competition about talent to analyse and process data, data policies on privacy and security, as well as the need to deploy new technologies to capture, store, secure, search, share and analyse the data.

5.6. 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.

For China, there is 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. However, 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.

Some examples of recent EU and China government policies are provided in the main report.

6. 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 city-wide 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 geographic 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 citizens and enterprises and utilising its resources more efficiently. The recommended 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 in Figure 4 The Smart City Staircase Roadmap towards Maturity.

Figure 4: The Smart City Staircase Roadmap towards Maturity
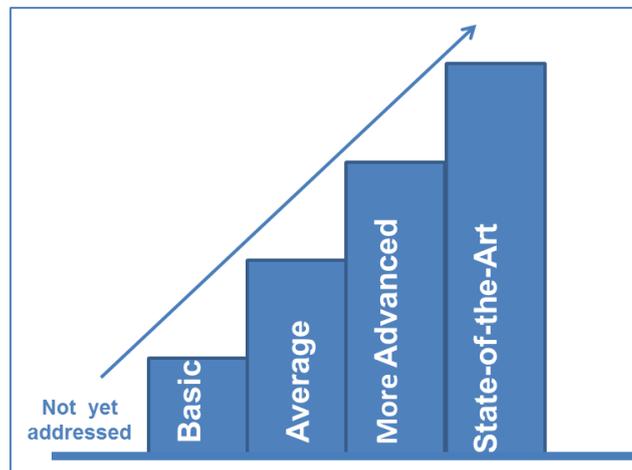
The "Roadmap towards maturity" recognises that some pilot smart cities may have no interest or do not have sufficient resources to achieve the highest possible level of smart city maturity for a given characteristic, for example "strategy" or "business models". Instead it provides guidance on how to 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 counter-productive. 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 counter-productive. 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 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 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; and
- case examples of smart cities documented in this report.

Although an assessment of the pilot smart cities level of maturity is provided in chapter 6, it is highly recommended 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 has 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.

6.1. 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 KPI's • ICT vision for the city	• Smart city KPI's benchmarked against international standards, which are made available to all stakeholders • ICT plans ensure major technology trends are included in their city planning

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 the smart city becomes a technology project rather than a project of improving the livelihood of the city.

Looking beyond the horizon

The objective of formulating a smart city strategy should not be focused on merely 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; or
- 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.

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 enables continuous assessment of the plan's progress and provides early alerts when implementation challenges arise. Some of the pilot smart cities have already implemented KPI's to measure their performance in meeting the smart city objectives and in a few cases pilot cities have benchmarked their KPI's 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.

6.2. Stakeholders

Level of Maturity			
Basic	**Average**	**More Advanced**	**State-of-the-Art**
• 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	• Uses multiple forms of interactive technologies to engage with citizens, e.g. Crowd-sourcing, 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

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 are 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, 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, economically or socially disadvantaged groups, is 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 - 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.

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.

6.3. 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	• City-wide governance structures with shared performance targets across departments	• City-wide governance structures with shared performance targets across departments
			• Processes in place to
			  ○ Allow stakeholders to participate in decision-making; and
			  ○ Ensure there is transparency and accountability of the various stakeholders

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.

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.

6.4. 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 **all** smart city objectives

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 value 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 chapter 2.2.2).

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 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.

6.5. 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 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

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 current does not have this capability.

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 non-financial outcomes of the project before it commences. In addition the process should assist in the negotiation and agreement of PPP contracts.

6.6. 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

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 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 modernization strategy.

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.

6.7. 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% city wide broadband coverage • ICT infrastructure managed or shared across all smart city projects • Funding for advanced broadband network (e.g. LTE, vehicular wireless network, sensors	• 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 the city

		etc.) and implementation city wide data centres for future smart city projects	'future proofs' its investment in ICT infrastructure

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, time line, etc. with the technology choice (e.g. LTE, FTTx, etc.) left open to meet the functional parameters.

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.

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 Programme Interfaces (APIs) and other standards enable 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) as well as various standards bodies in China such as the China National IT Standardisation TC (NITS) play an important role in identifying who is already active in developing standards on these topics and co-ordinating ongoing smart city standards 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.

Policy framework facilitating modernization

Given the high cost of ICT infrastructure investment, the policy framework should allow flexible designs of public-private partnership to co-finance 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.

6.8. 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 city wide	• 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 crowd-sourcing initiatives

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.

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. Future services can then be quickly and efficiently added in a modular way without necessarily causing large disruptions for the overall system.

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.

7. 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 policy-makers, industry and the 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 perspective 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, 28-29 April 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 best address these challenges and to suggest, where applicable areas for further cooperation. 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 others' 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 practise" 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 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 EU.

Annex 1: Smart City Assessment Framework

	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 Indictors (KPI's) that are used to measure the city's performance in meeting the Smart City objectives - Are KPI's 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 & 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 crowd sourcing 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?
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 inter-relationships 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.?
		   o How much of the funding was from private and public sources?
		   o 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 over-runs, 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,
		   o What, if any, was the amount of business and/or jobs created
		   o What, if any, was the increase in GDP?
		   o What, if any, were the reduction in C02 emissions, traffic congestion, etc. and the value in financial terms?
		   o How the health service was 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
		   o Risk-sharing initiatives e.g. technology vendor / Telco providing the IT infrastructure in return for a share of future revenue streams
		   o Using revenue generated from road congestion charges to finance public transport systems.

7	ICT Infrastructure	▪ Describe the current investment in ICT infrastructure i.e. hardware and software assets, including
		   o Broadband (fixed and wireless) network penetration
		   o Data centre infrastructure
		   o Geographic Information System technology
		   o Public, Private, Hybrid cloud platforms
		   o Passive/ intelligent sensors
		   o Video monitoring, etc.
		▪ Who are the key suppliers, vendors, System Integrators, 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
	  o Education
	  o Economic stimulus
	  o Environment
	  o Energy and utilities
	  o Food safety
	  o Health
	  o Intelligent buildings
	  o Logistics
	  o Community Development
	  o Open Data
	  o Prevention e.g. crime, disasters
	  o Public services /administration
	  o Transportation
	  o Waste management
	  o Water
	  o 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
		  o The date the service was launched
		  o 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
		  o Who the services is targeting e.g. businesses, health service providers, older people (60+), unemployed people, etc.
		  o The benefits (financial and non-financial) resulting from the services
		  o 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
		  o 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.

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
		  o Telecommunications
		  o Building regulations
		  o Security and privacy
		  o Intellectual Property
		  o Etc.
		▪ Describe what polices have been put in place to ensure the physical Smart City infrastructure is secure, for example
		  o Disaster recovery management of ICT and other city infrastructure such as electricity, gas, water, etc.
		  o Business Continuity planning
		▪ Describe any other areas where the city has developed new policies to improve the outcome of Smart City developments.

Annex 2 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 KPI's • Smart city strategy or plan for the city	• Smart city KPI's benchmarked against international standards, which are made available to all stakeholders • ICT plans ensure 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	• Uses multiple forms of interactive technologies to engage with citizens, e.g. Micro-blog, mobile social applications, Crowd-sourcing, 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

Governance	• Departmental governance structures	• Cross-departmental governance structure is in place to ensure collaboration across the city planning development process	• City-wide governance structures with shared performance targets across departments	• Processes in place to
				  o Allow stakeholders to participate in decision-making; and
				  o Ensure there is transparency and accountability of the various stakeholders
				•

Funding	• Funding for pilot project but no plan to expand funding beyond the pilot	• 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	• No funding issues and funding available to meet **all** smart city objectives

34

	• Basic monitoring of financial expenditure		• monitor financial expenditure	
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)	• Uses a variety of business models that have been implemented for full scale projects
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% city wide 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 city wide data centers 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 o Measures in place to ensure 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 city wide	• 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 crowd-sourcing initiatives